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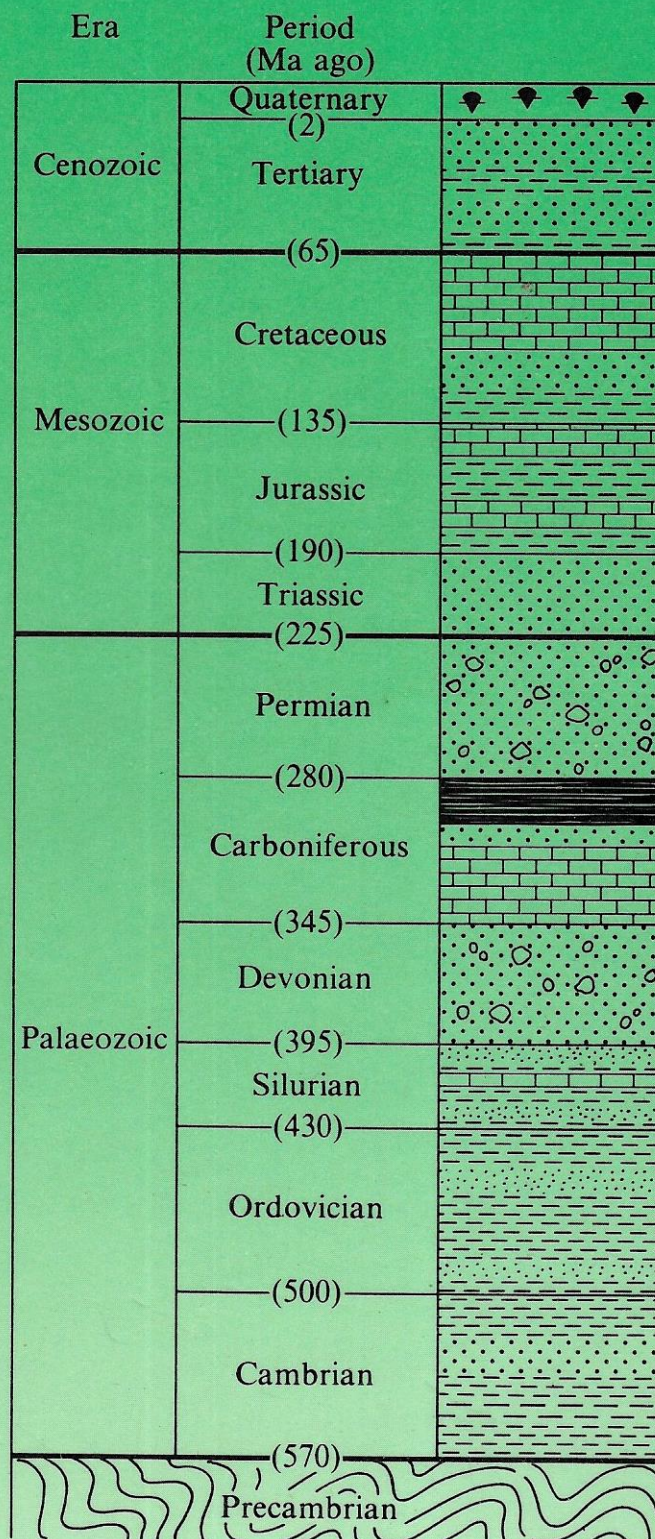


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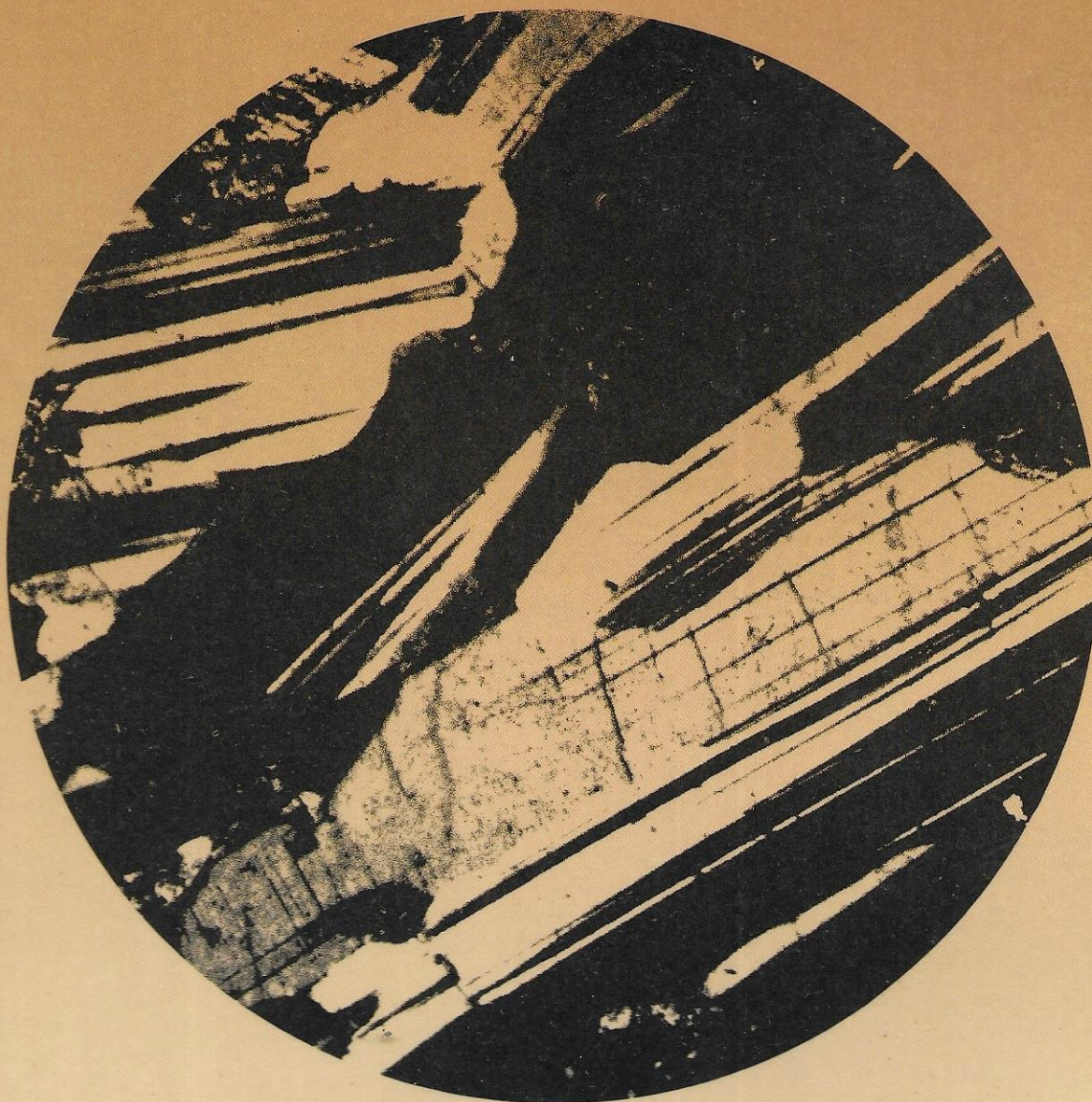
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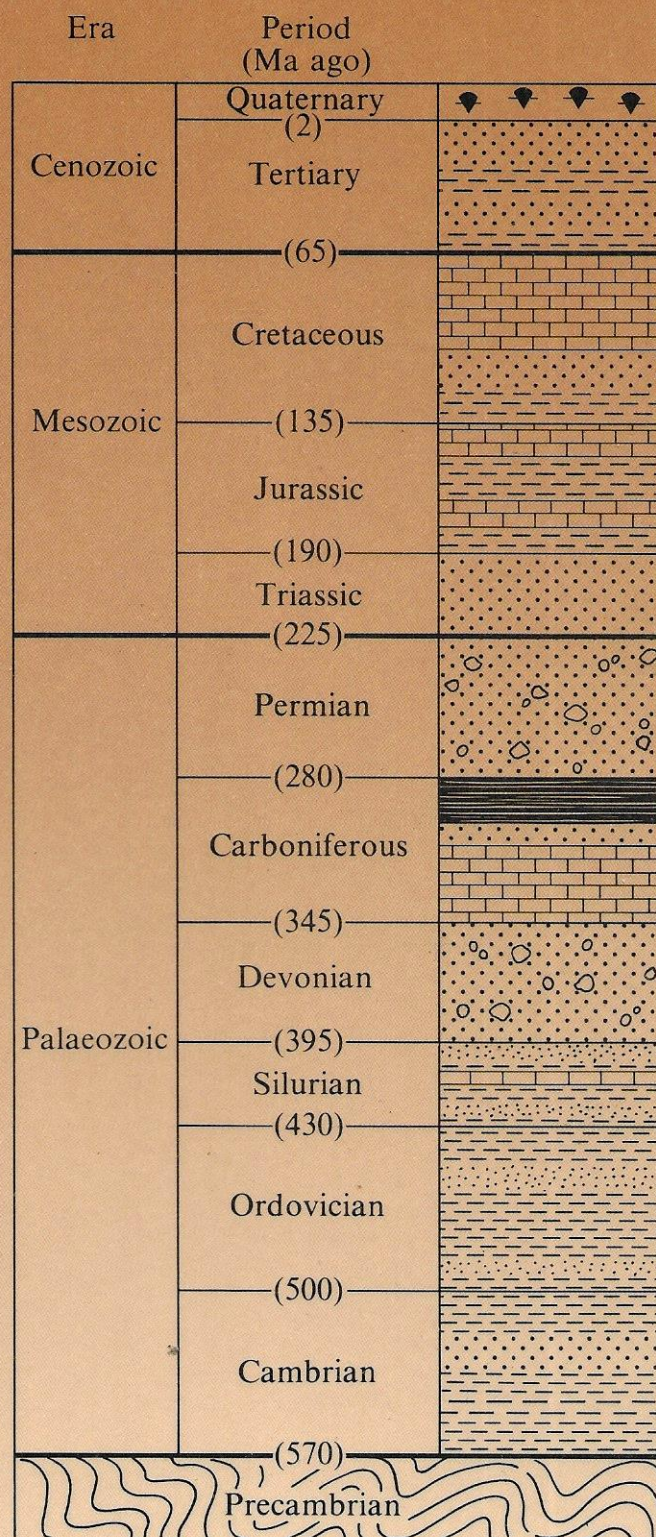


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## Block 2 Earth Materials

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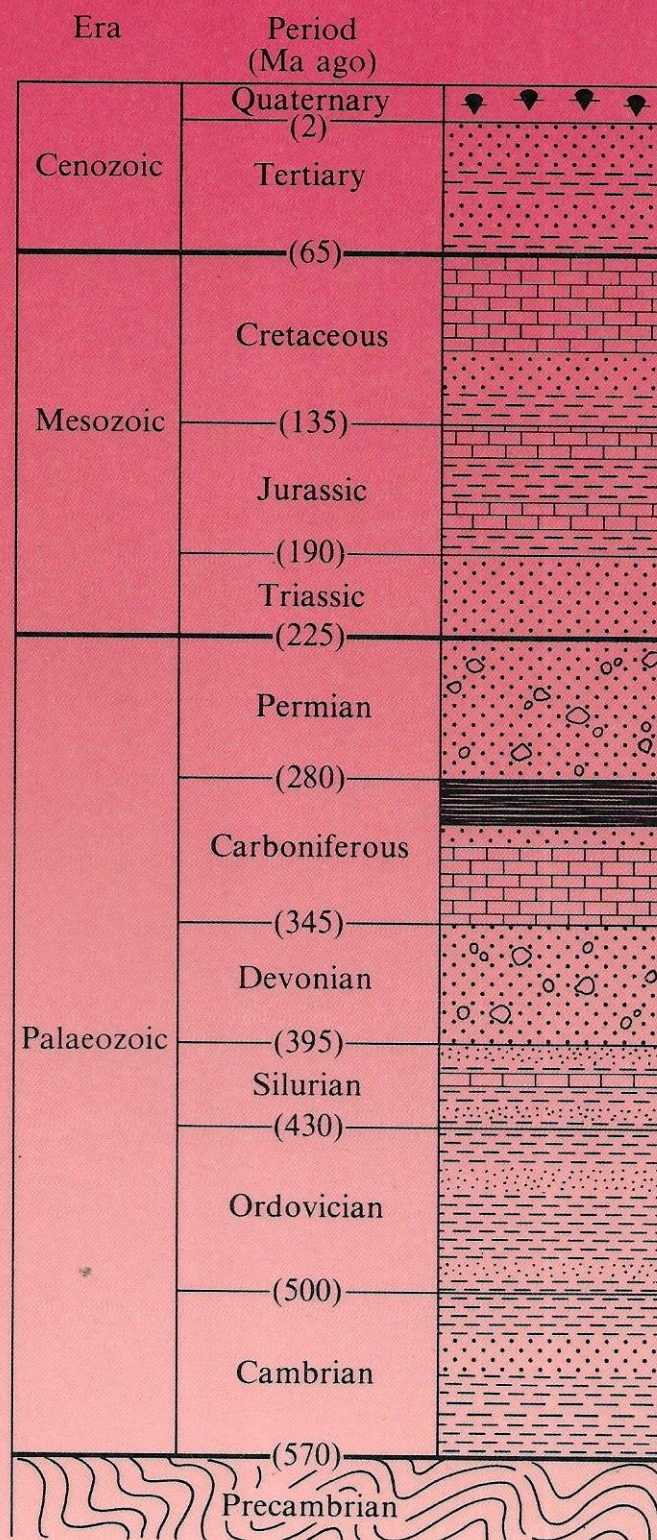


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## Block 3 Internal Processes

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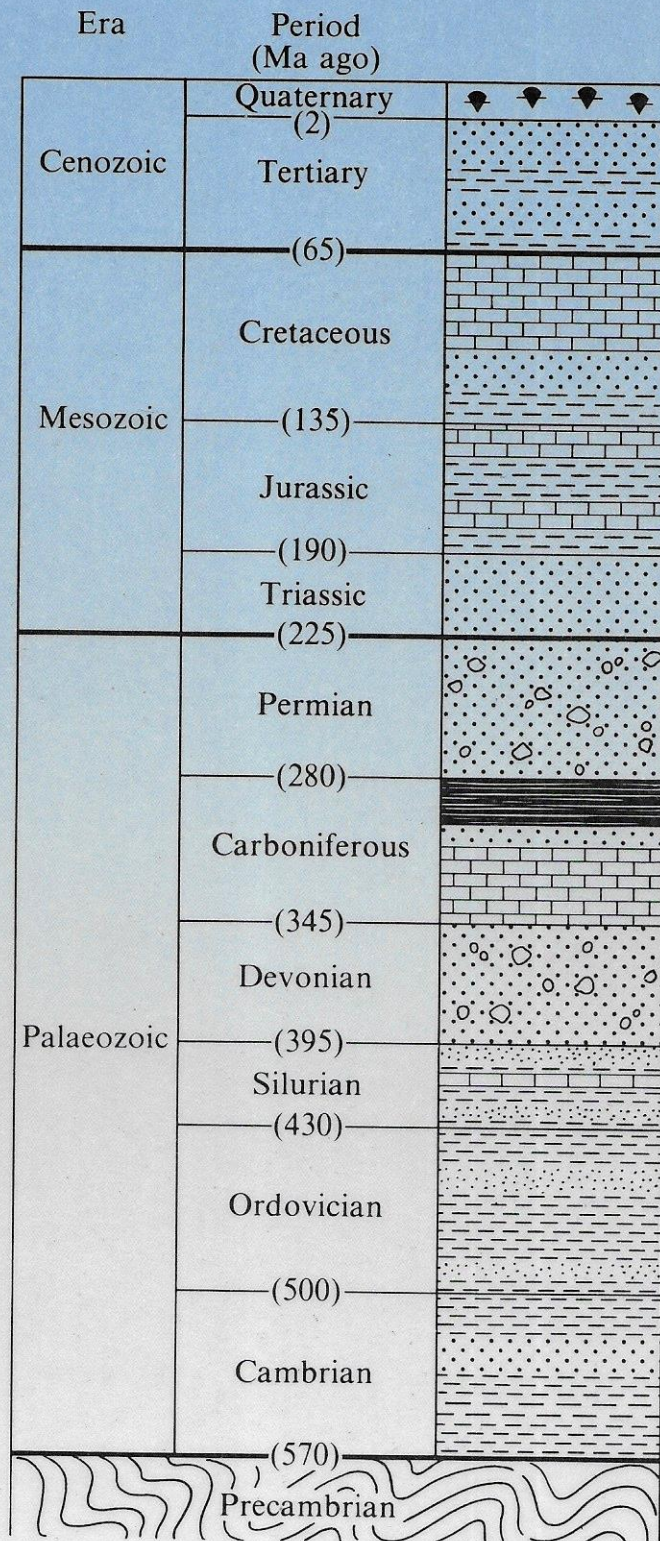


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## Block 4 Surface Processes

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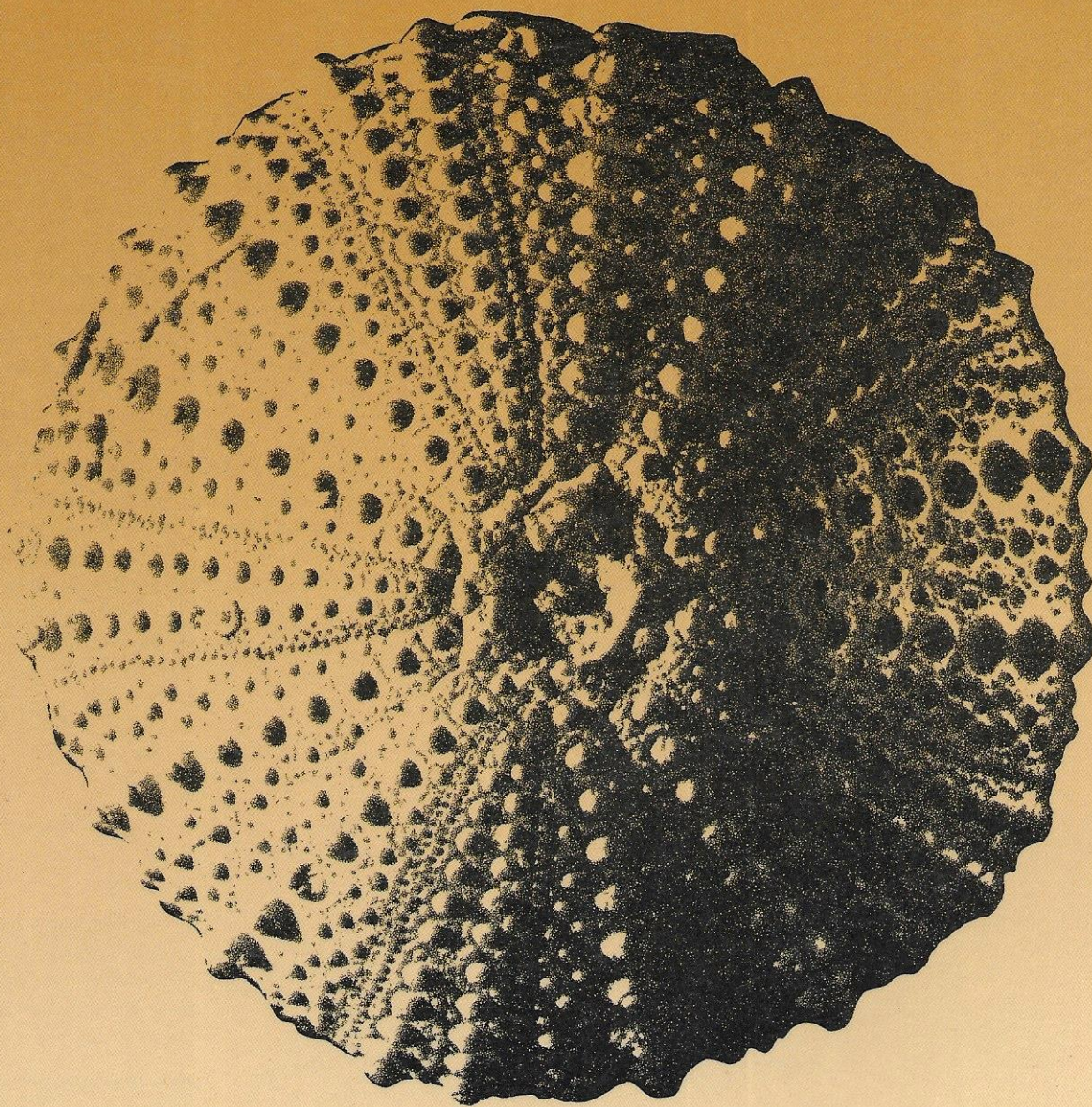
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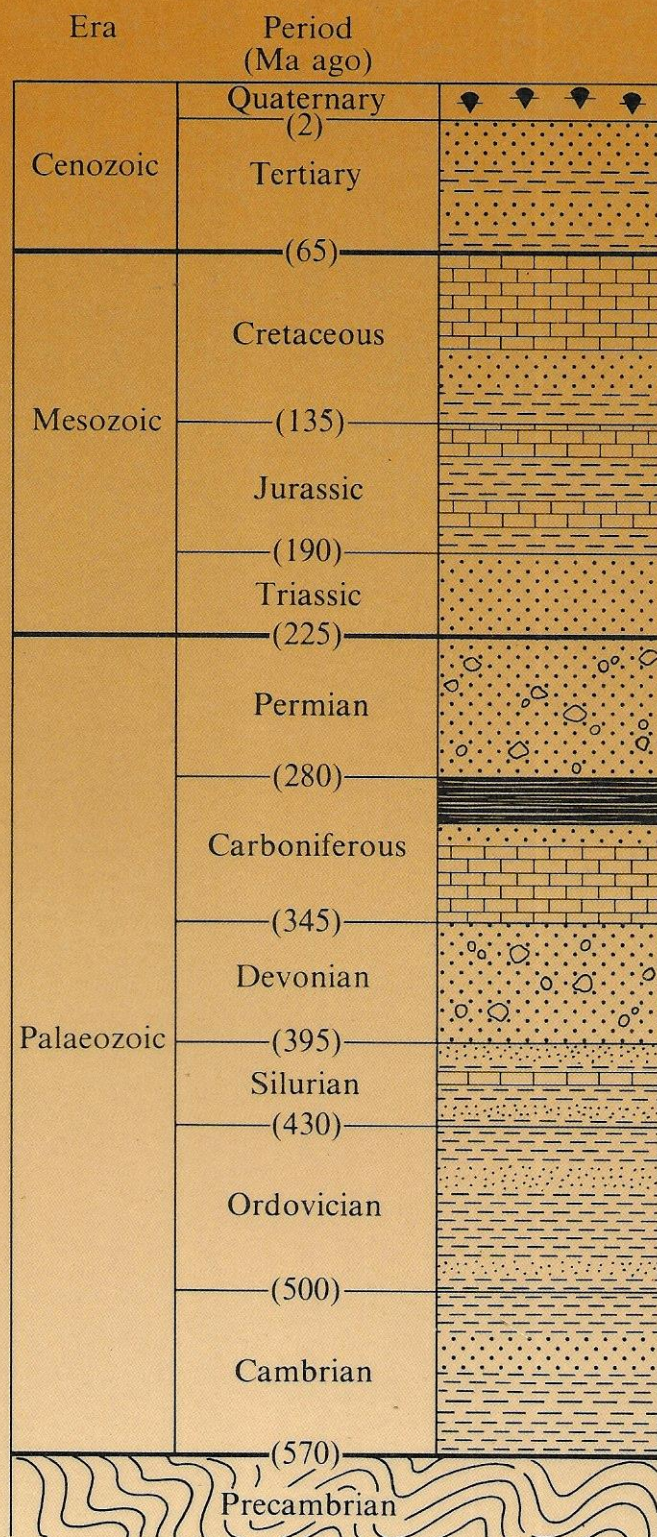


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## Block 5 Fossils

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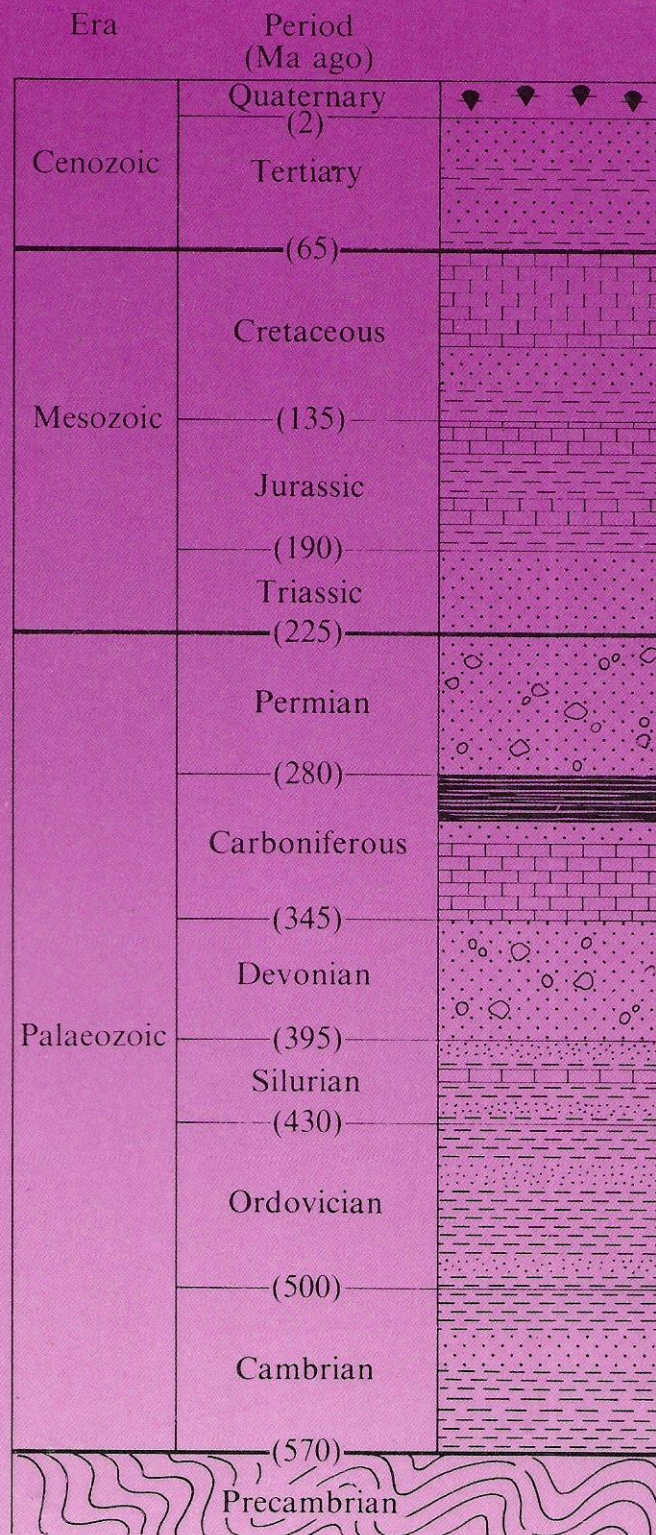


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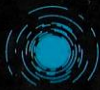
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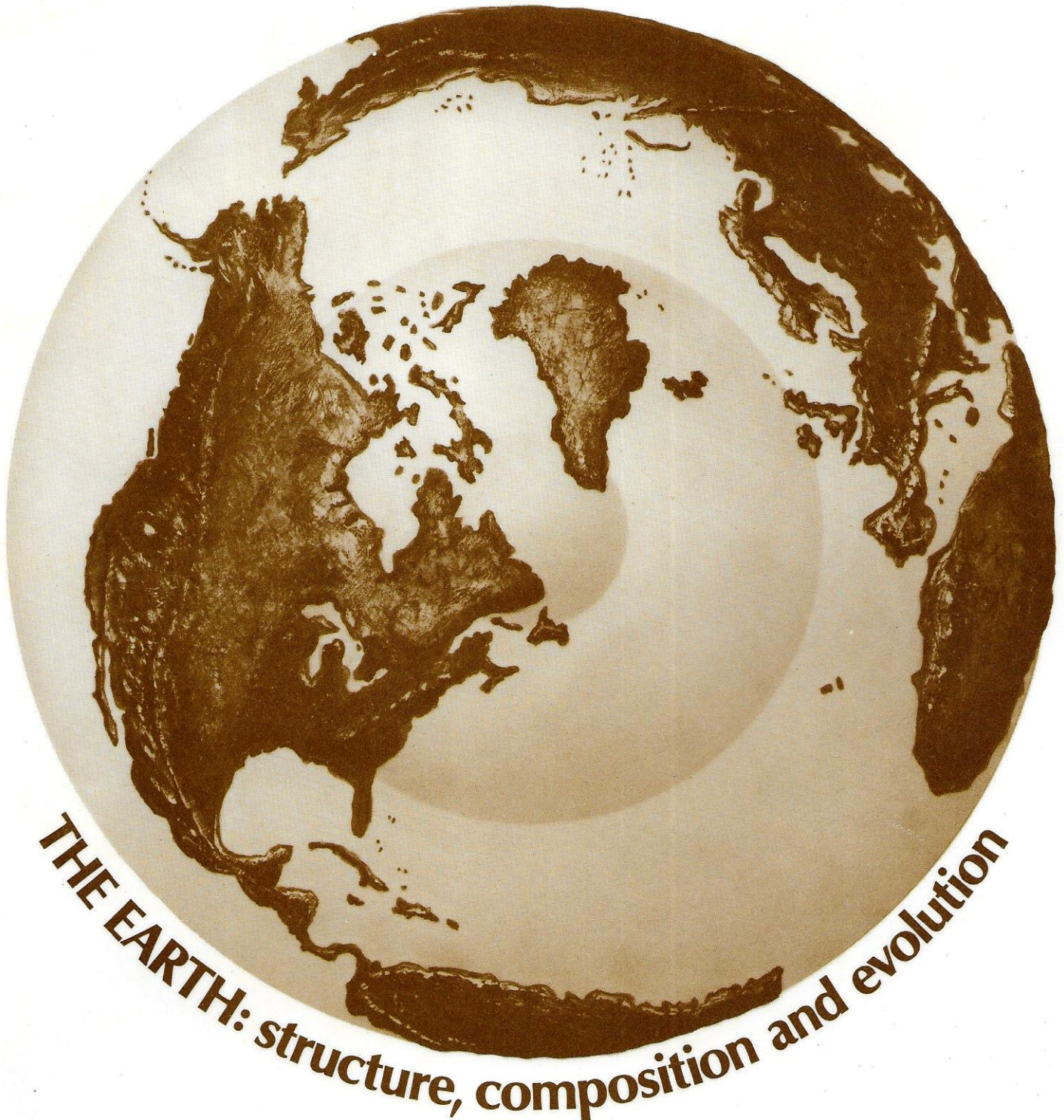




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Block 4  
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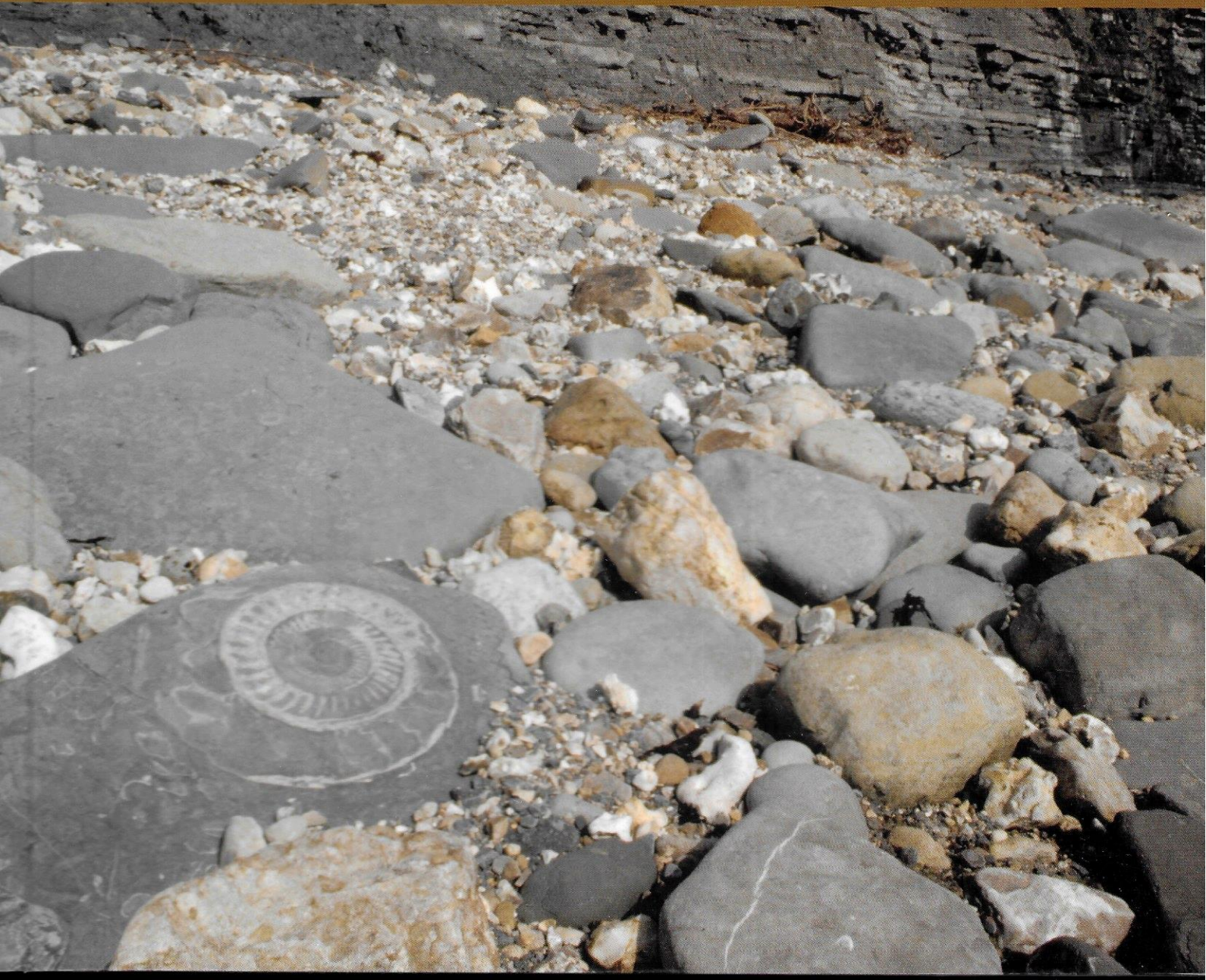
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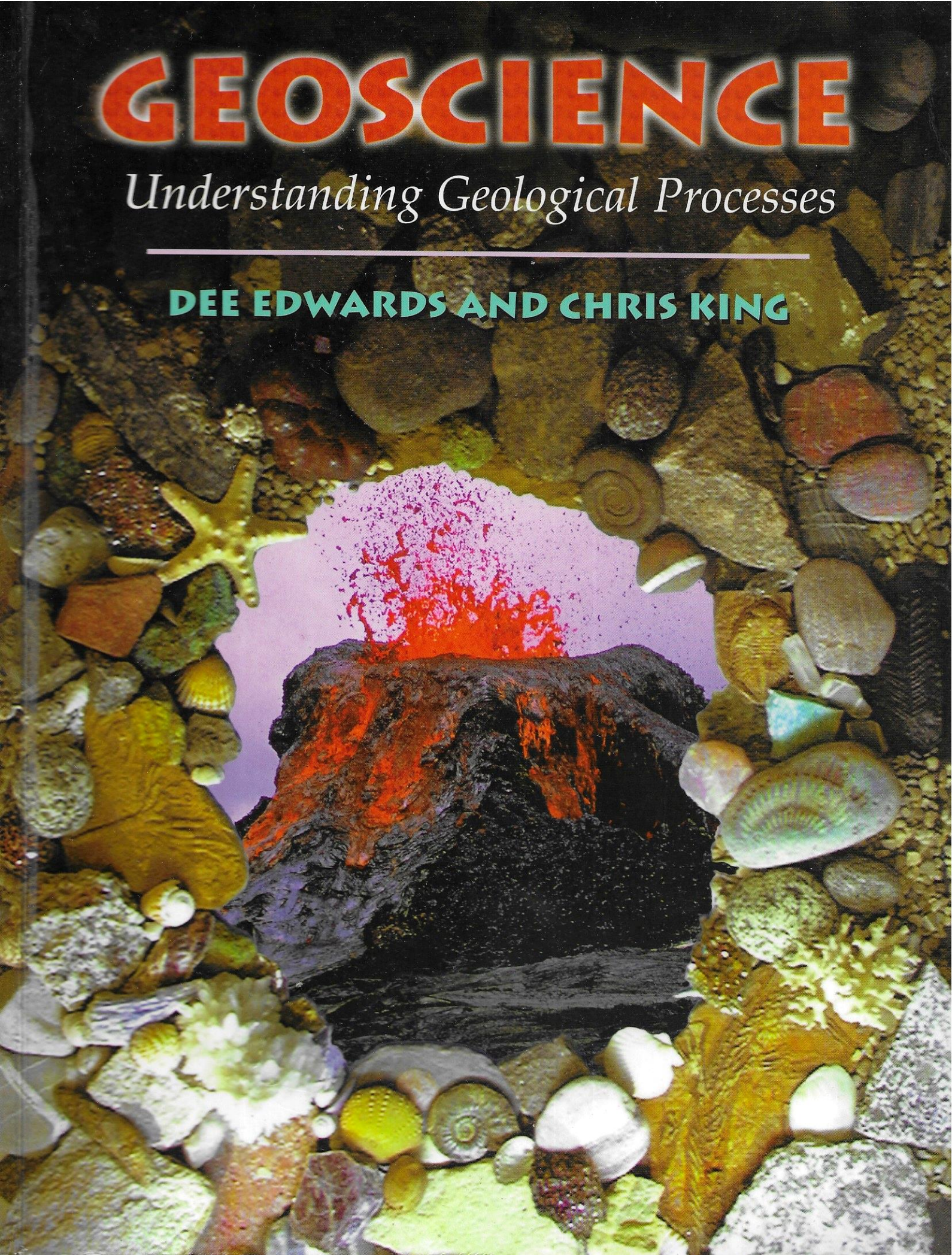


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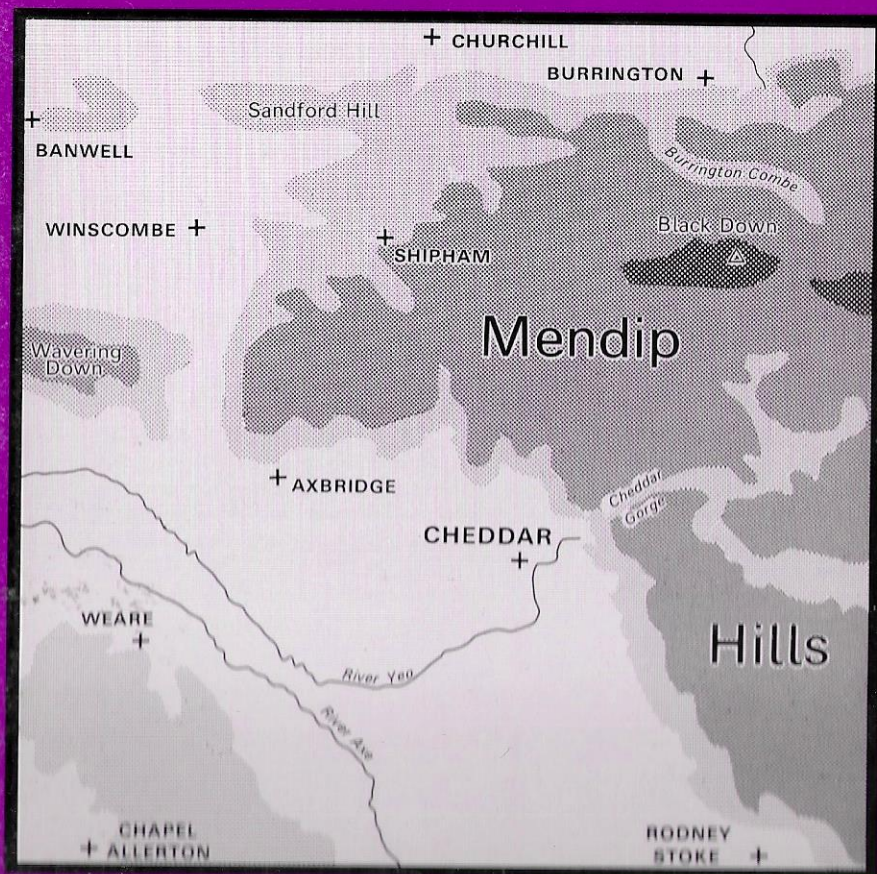
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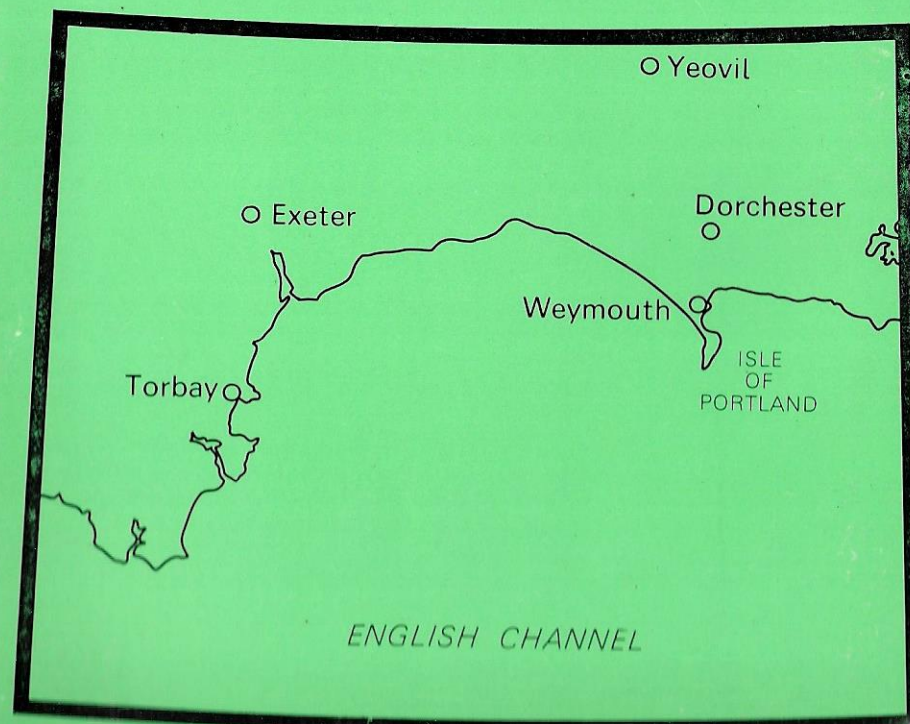


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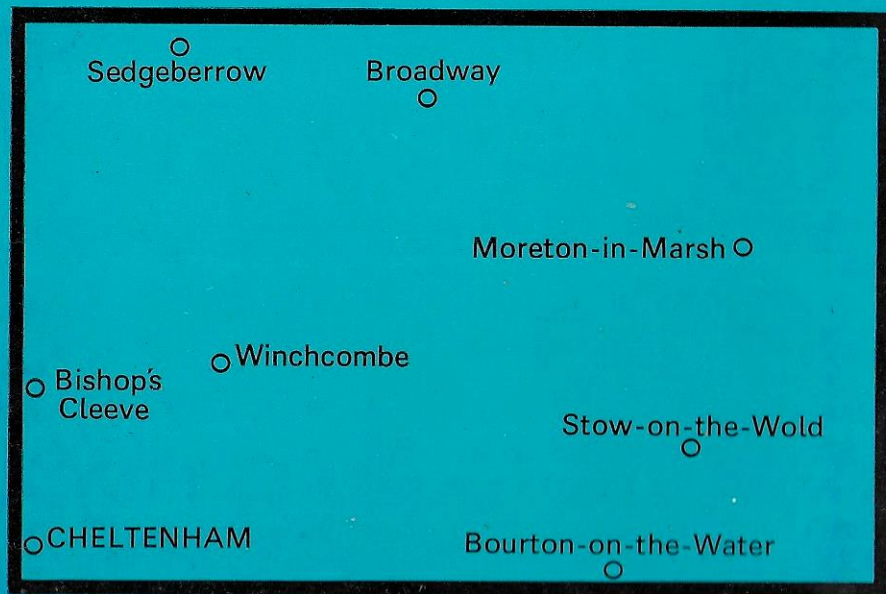
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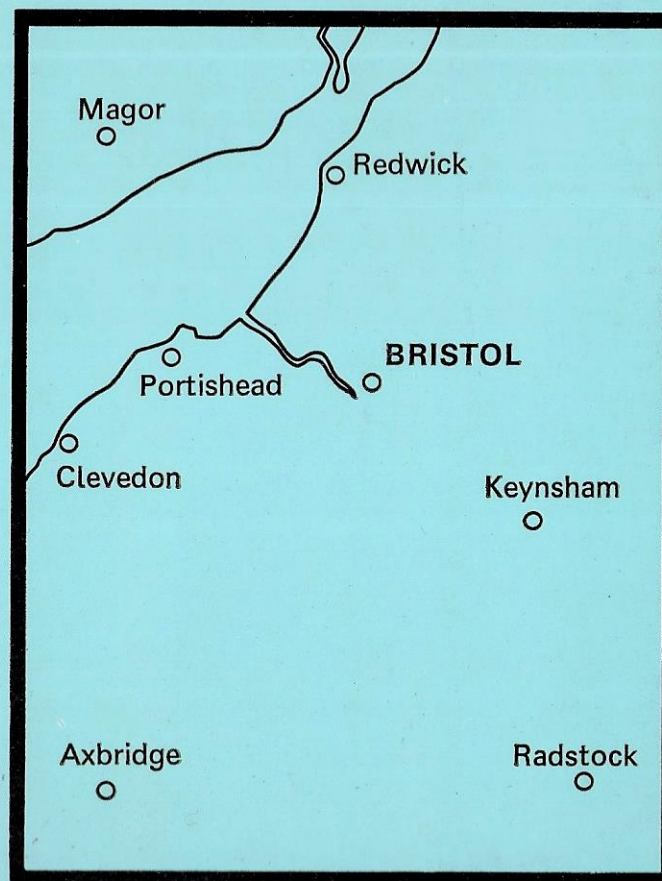
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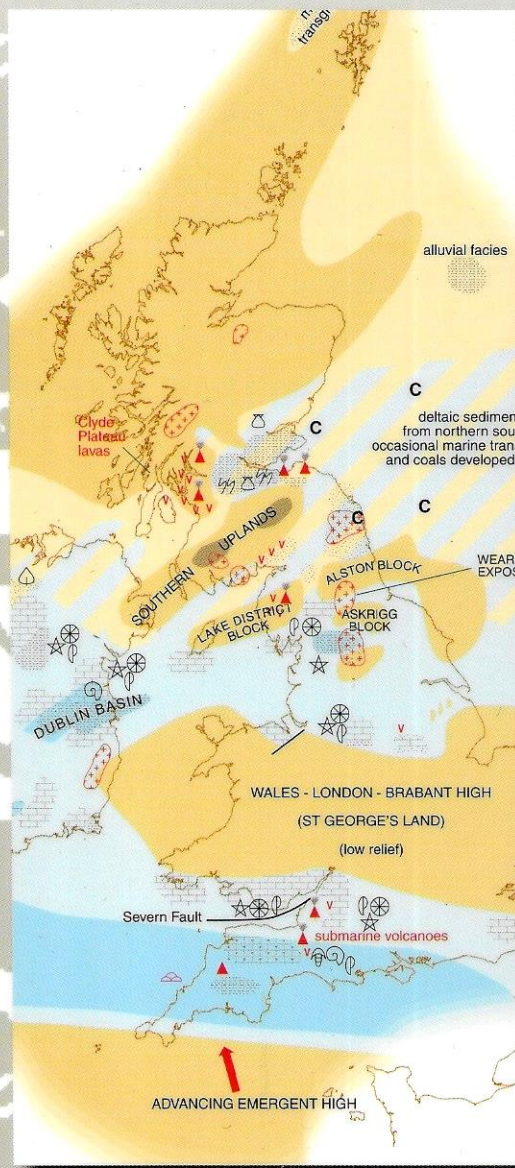
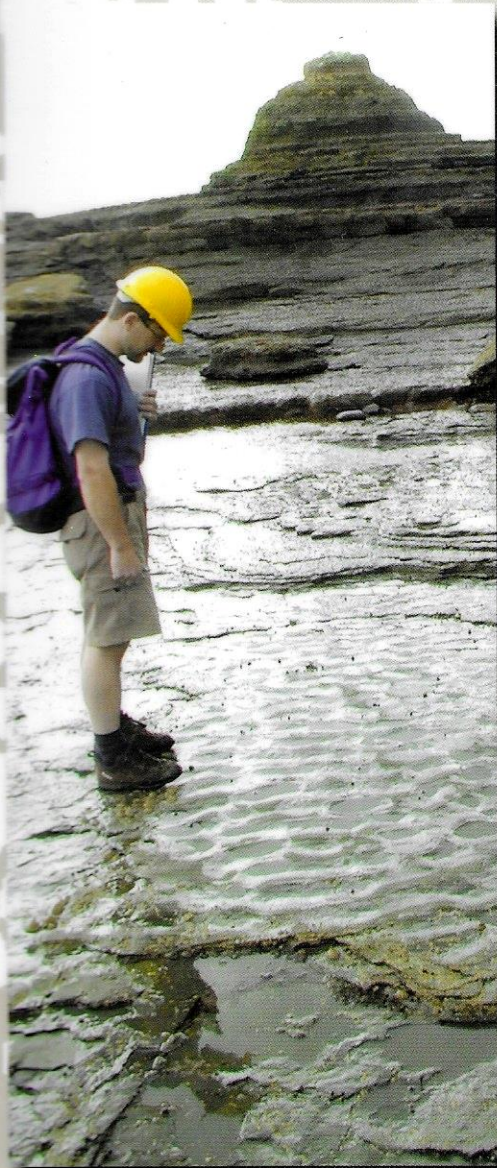
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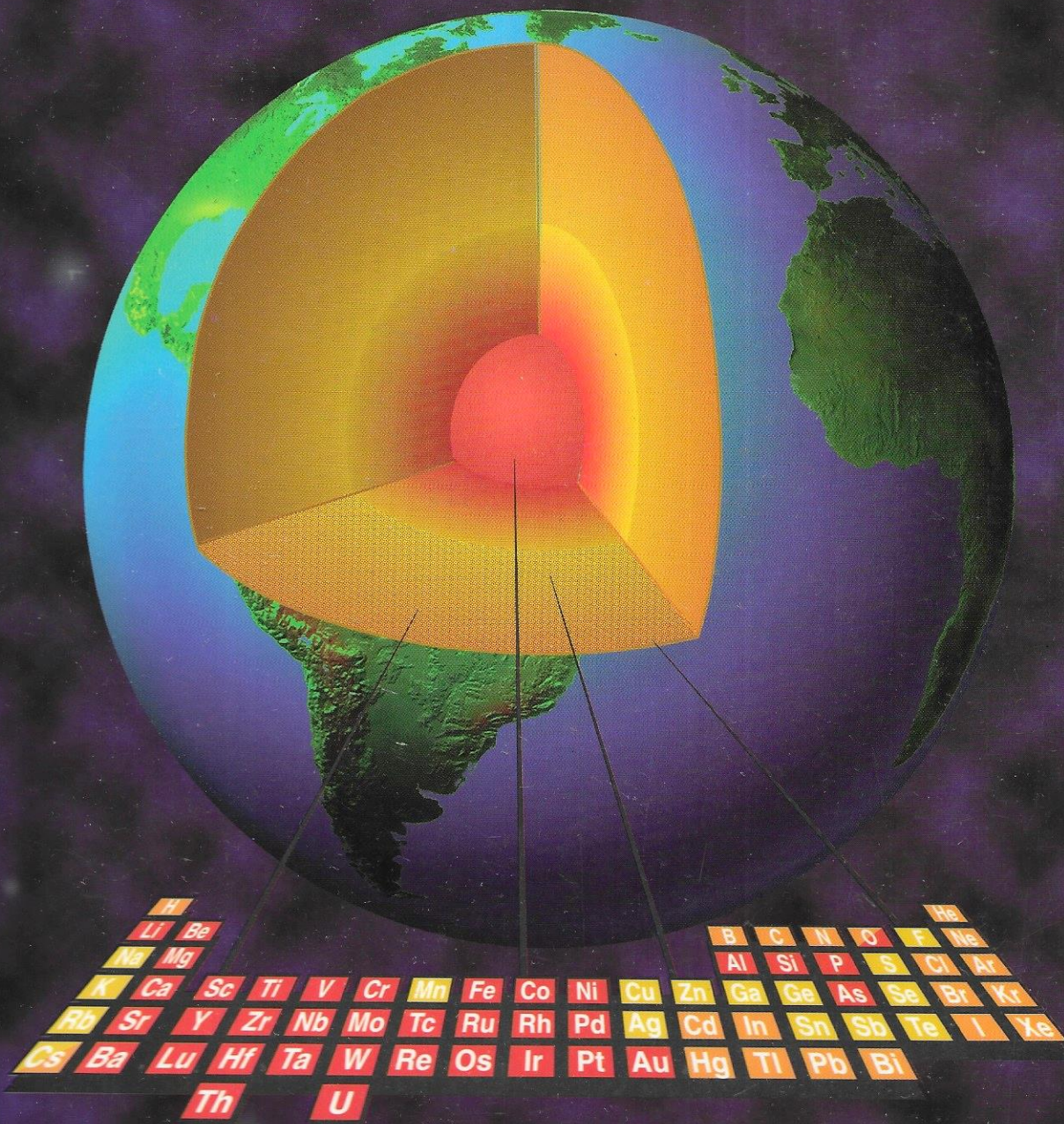
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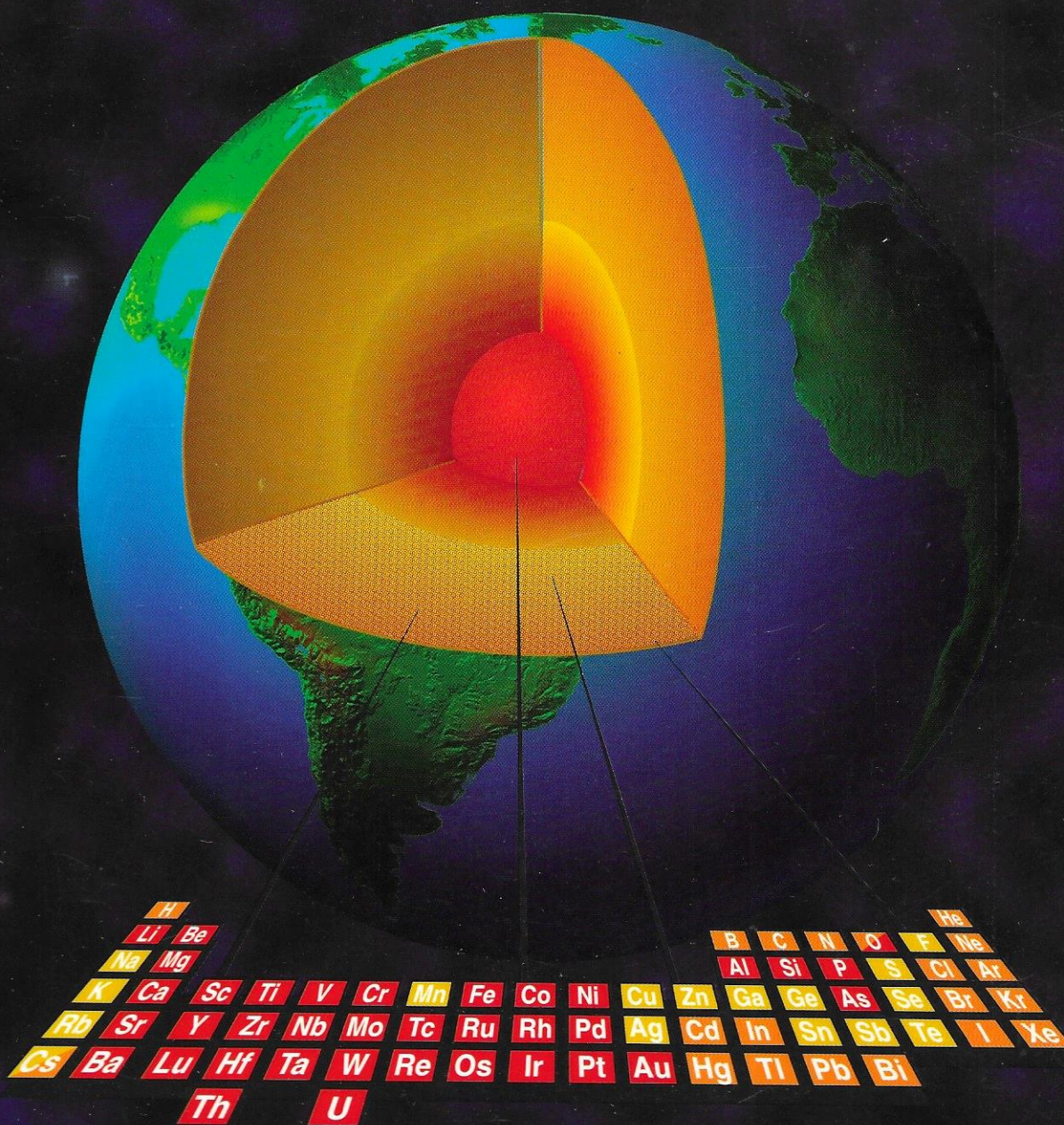
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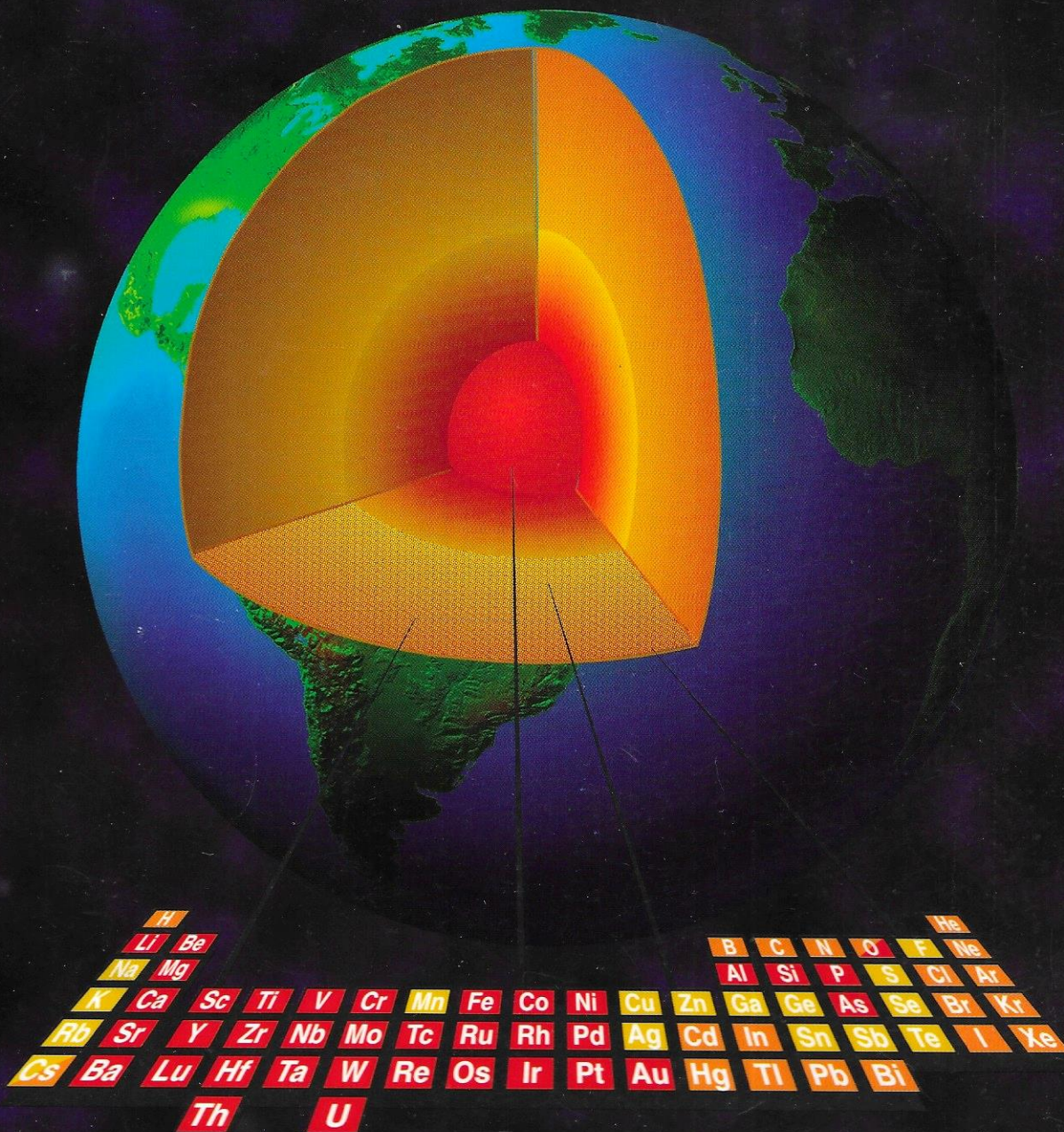
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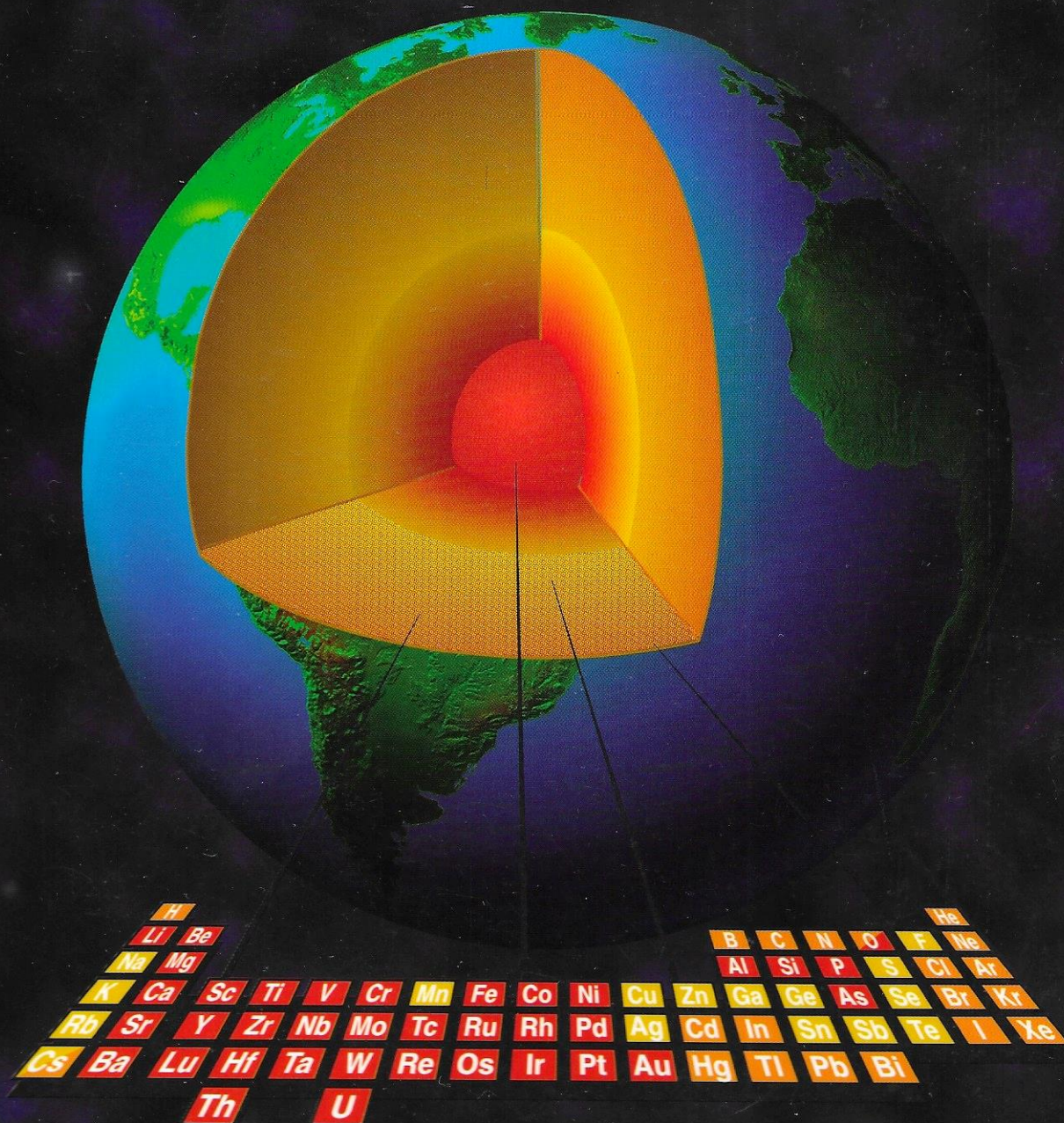
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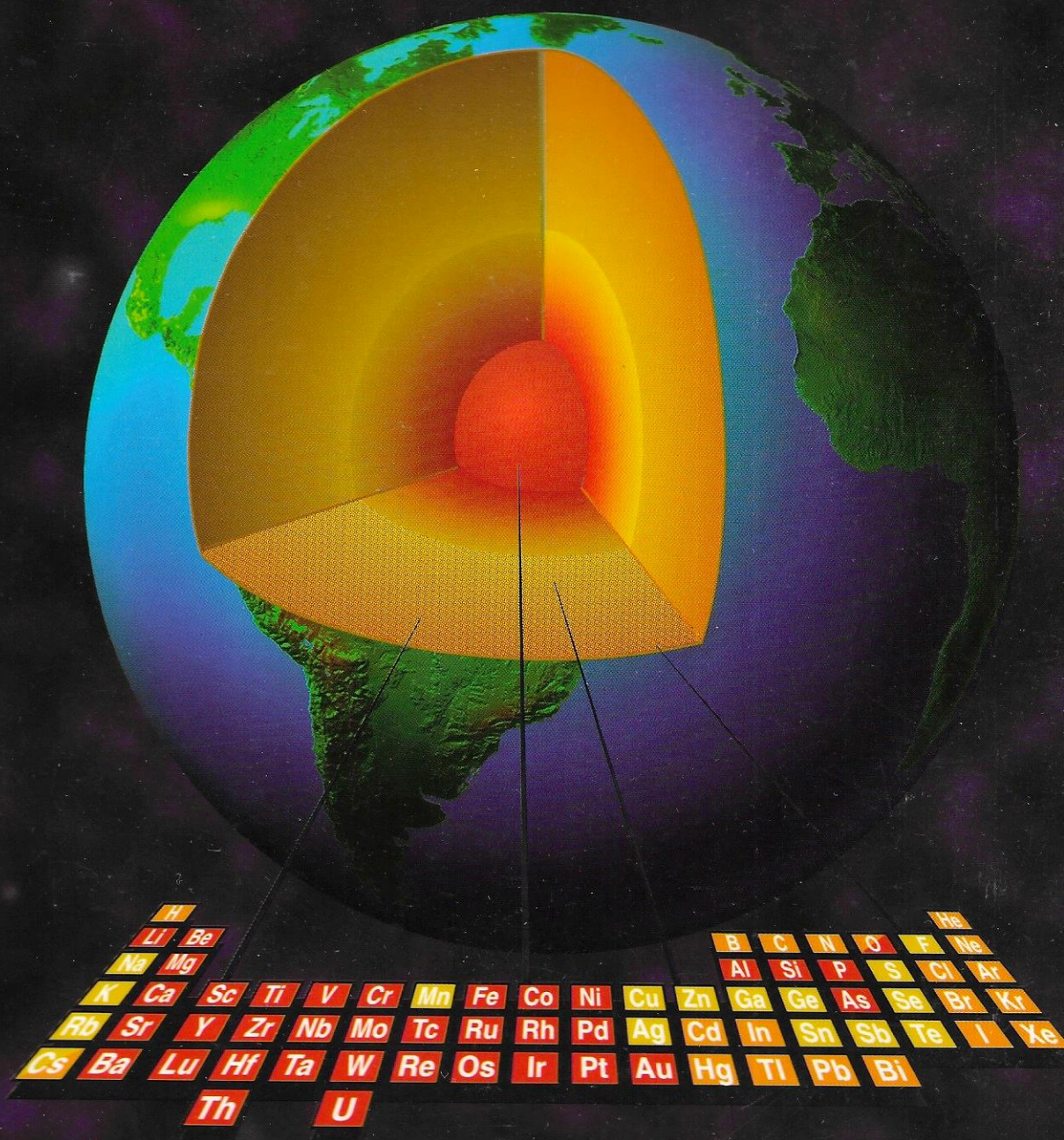
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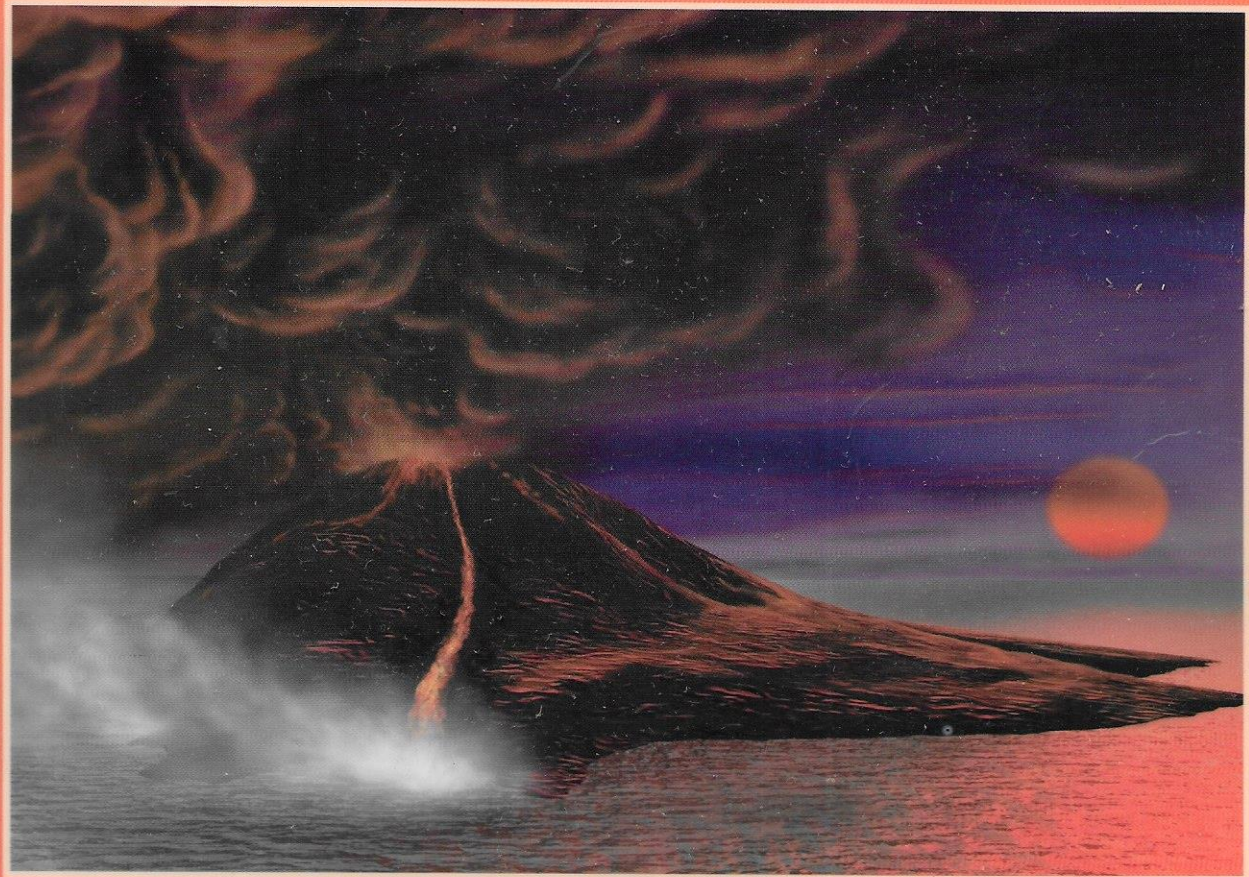
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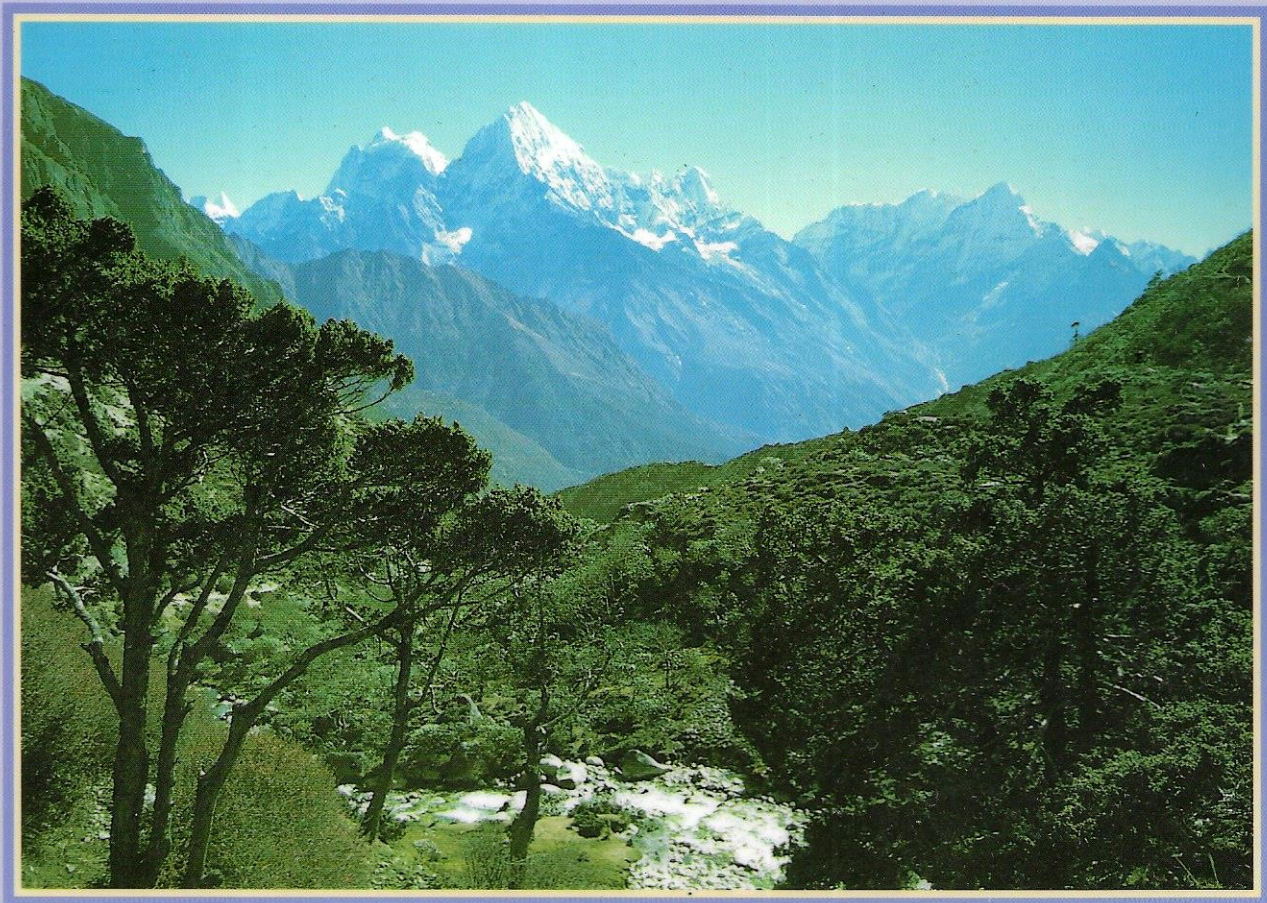
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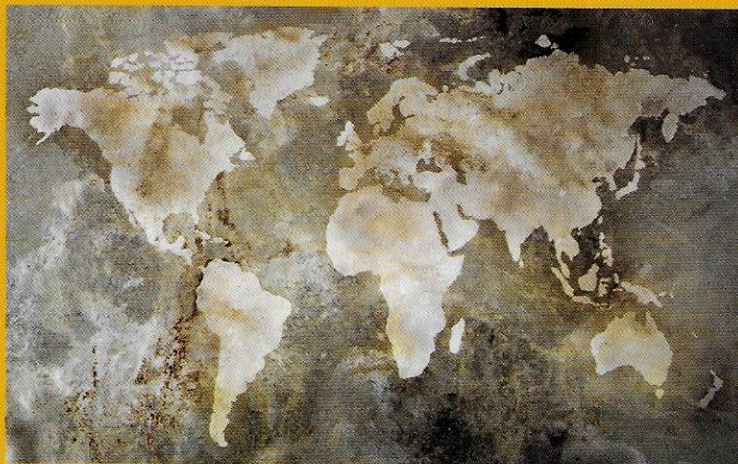
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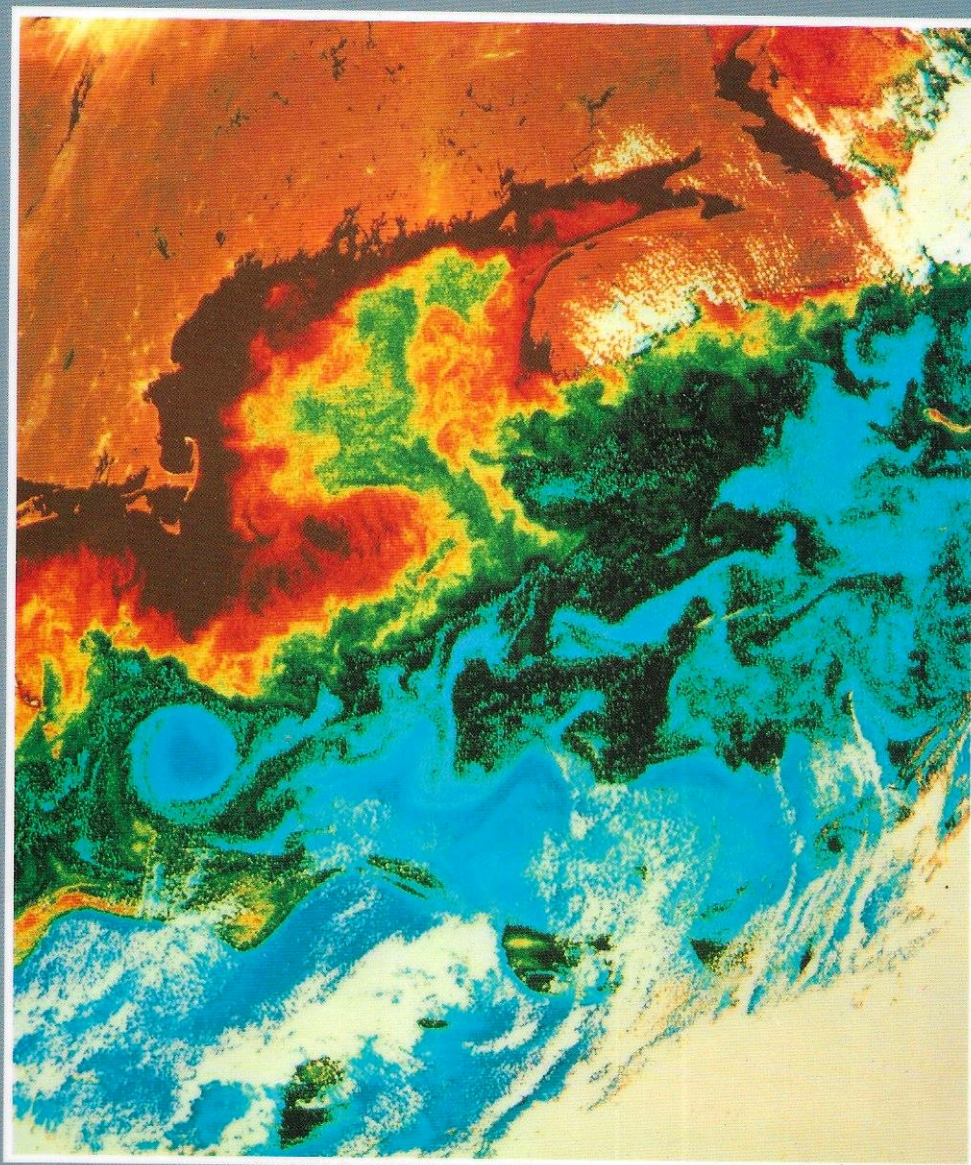
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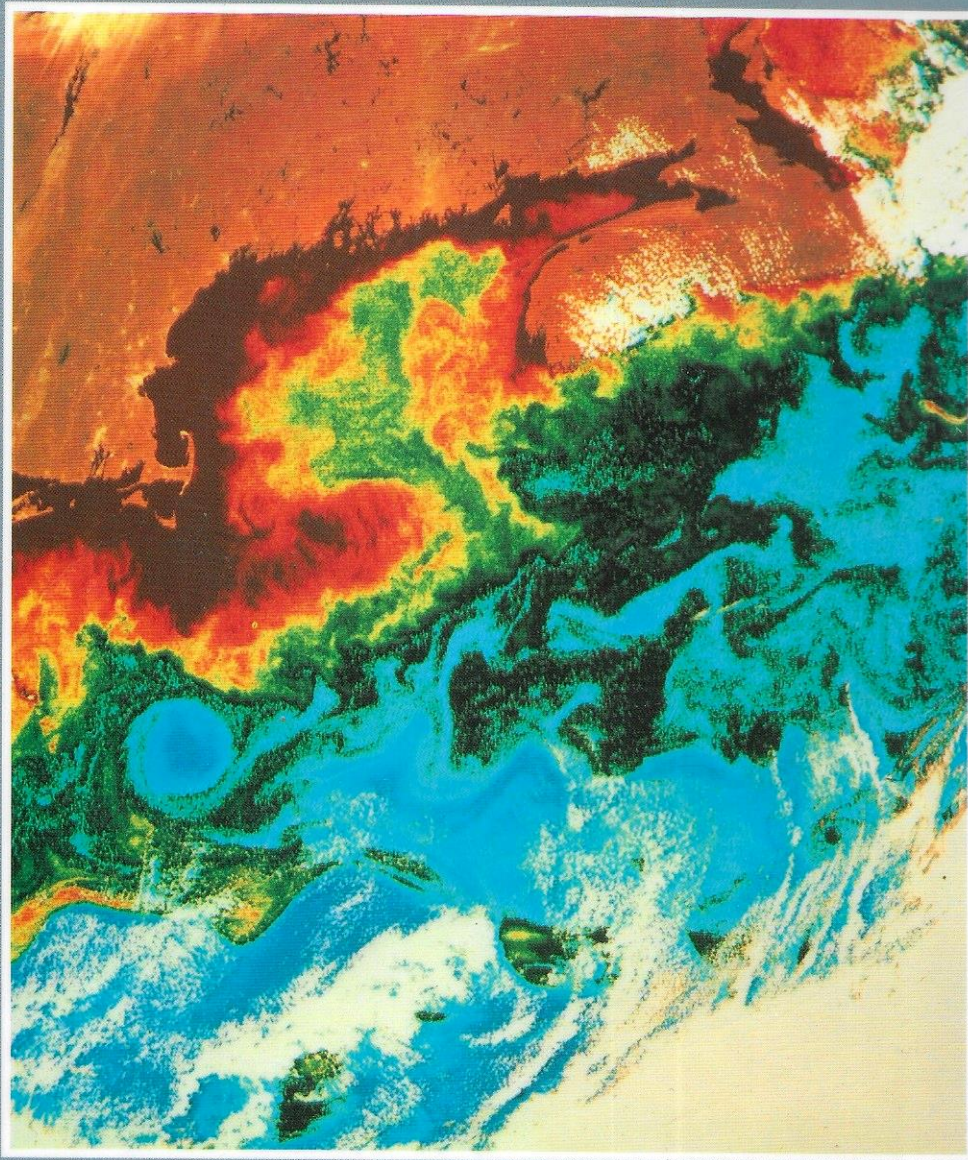
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### **CONTENTS**

Water, air and ice. Temperature in the oceans. Salinity in the oceans. Density and pressure in the oceans. Light and sound in seawater. The seawater solution. Seawater and the global cycle. Suggested further reading. Answers and comments to questions.

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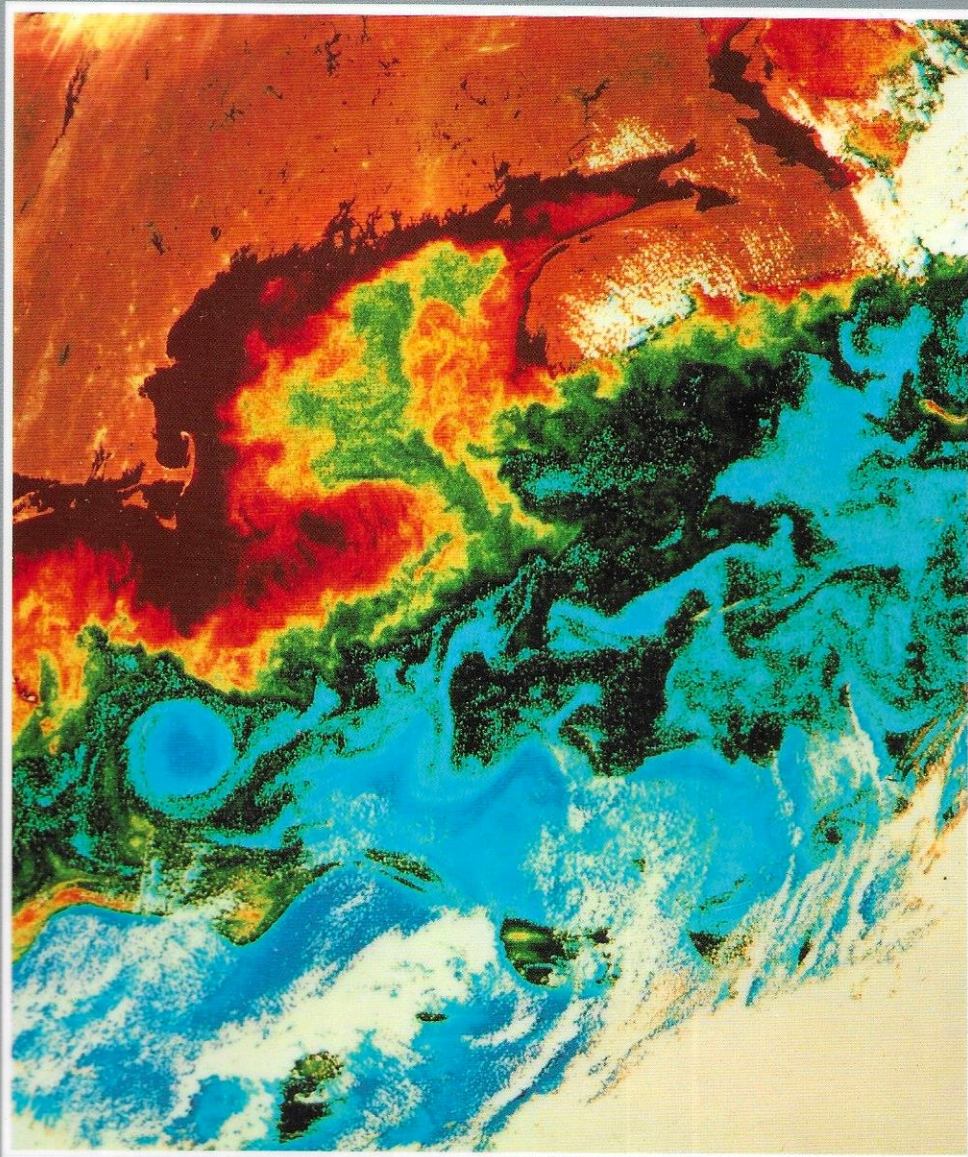
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SECOND  
EDITION





### **S330 VOLUME 3**

Extensively revised and updated for its second edition, this Volume belongs to a series on oceanography. It is designed so that it can be read on its own or studied as part of the Open University third-level course, S330 *Oceanography*. The first two Chapters outline the causes of circulation patterns in the atmosphere and oceans, emphasizing the interactions between them. Chapter 3 deals with surface circulation (including mesoscale eddies), using a minimum of mathematics. Chapter 4 reviews ideas about ocean circulation (with special reference to the North Atlantic gyre), and Chapter 5 describes major current systems at high and low latitudes, including climatic oscillations such as El Niño. Global fluxes of heat and freshwater, and the formation of sub-surface water masses, are the themes of the final Chapter.

### **CONTENTS**

Introduction. The atmosphere and the ocean. Ocean currents. The North Atlantic gyre: observations and theories. Other major current systems. Global fluxes and the deep circulation. Suggested further reading. Answers and comments to questions.

### **OTHER TITLES IN THE OCEANOGRAPHY SERIES**

THE OCEAN BASINS: THEIR STRUCTURE AND EVOLUTION  
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WAVES, TIDES AND SHALLOW-WATER PROCESSES  
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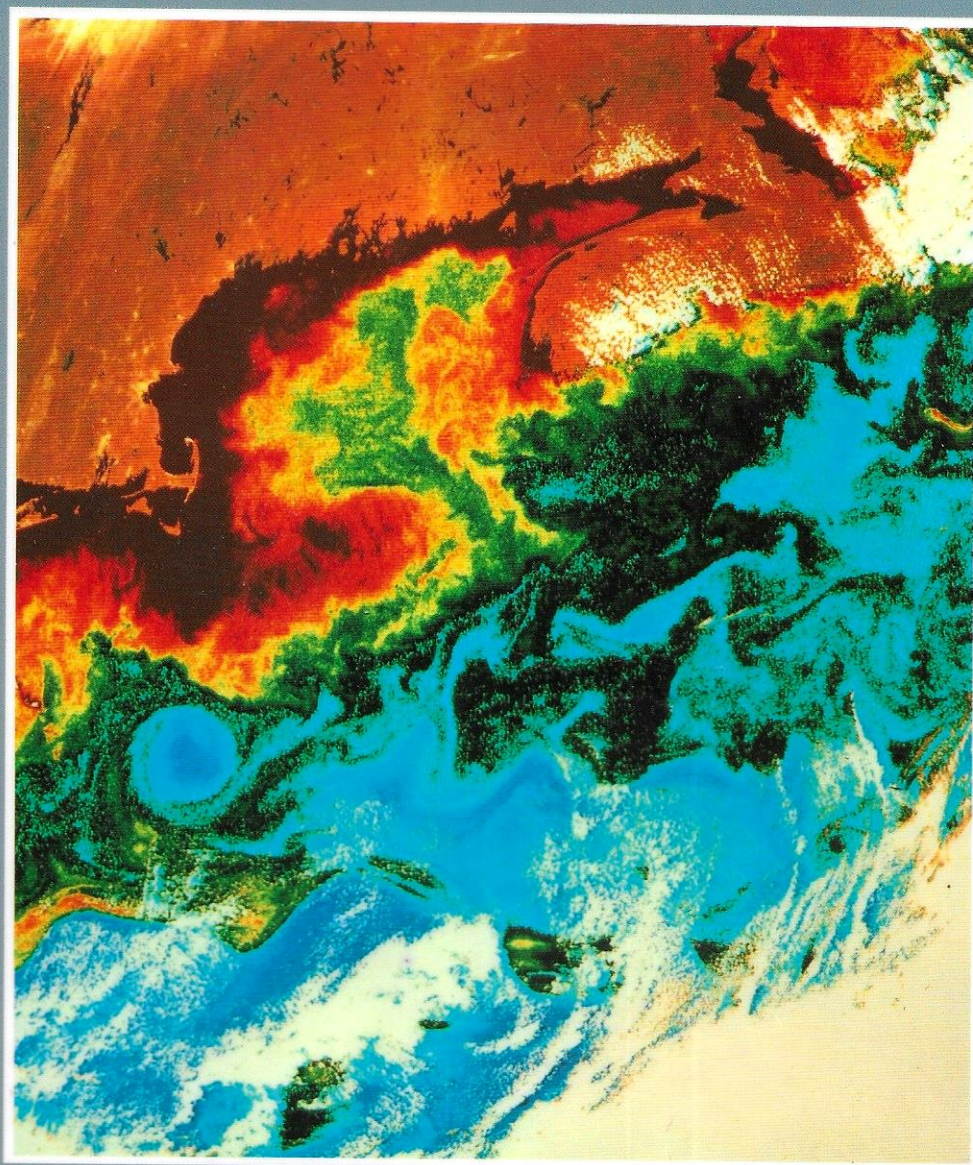
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# WAVES, TIDES AND SHALLOW-WATER PROCESSES

PREPARED BY AN OPEN UNIVERSITY COURSE TEAM

SECOND  
EDITION





#### **S330 VOLUME 4**

Completely revised and updated for its second edition, this Volume belongs to a series on oceanography. It is designed so that it can be read on its own or studied as part of the Open University third-level course, S330 *Oceanography*. We begin by describing the characteristics of waves and tides, and their behaviour in shallow water. After outlining the sources of sediment supply to the oceans, we consider some theoretical aspects of sediment movement and deposition by currents. After looking at wave action in the littoral zone, we explore the interplay of tidal currents, river flow and wave action in estuaries and deltas. The final Chapter provides an overview of shelf processes.

#### **CONTENTS**

Waves. Tides. Introduction to shallow-water environments and their sediments. Principles and processes of sediment transport. Beaches. Estuaries, lagoons and tidal flats. Deltas. Shelf seas.

#### **OTHER TITLES IN THE OCEANOGRAPHY SERIES**

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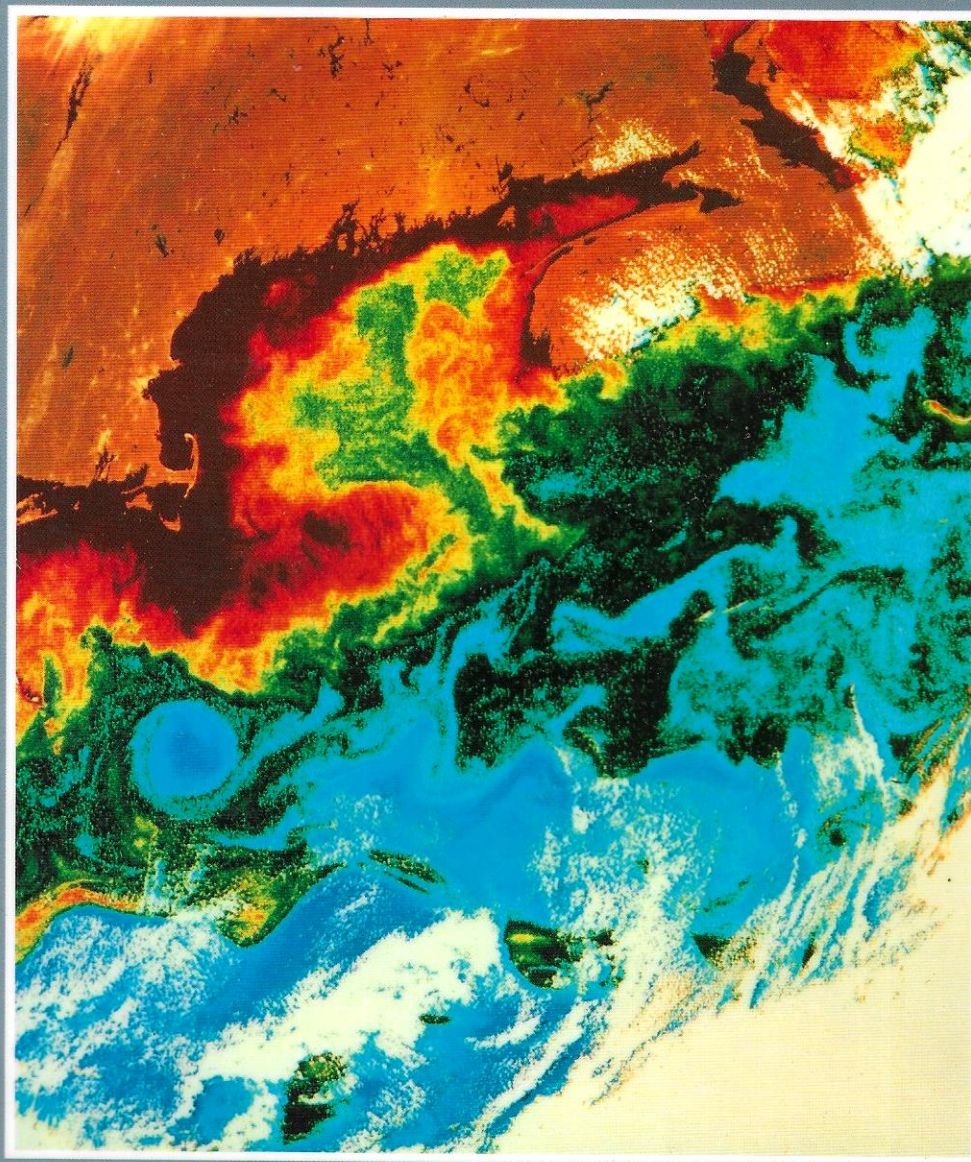
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# MARINE BIOGEOCHEMICAL CYCLES

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### **S330 VOLUME 5**

This Volume belongs to a series on Oceanography. It is designed so that it can be read on its own, or studied as part of the Open University third-level course, S330 *Oceanography*. After a brief introduction to sea-floor sediments, we show how the activities of marine organisms cycle nutrients and other dissolved constituents within the oceans, and influence the rates at which both solid and dissolved material is removed to sediments. Chapter 3 reviews the carbonate system and we also show how the sediments that come from continental areas may be transported to the deep sea. We then go on to explore what sea-floor sediments have taught us about the history of the oceans, and we conclude by describing the biological and chemical processes that continue long after sediments have been deposited on the deep sea-floor.

### **CONTENTS**

Introduction. Biogeochemical processes in seawater. The accumulation of deep-sea sediments. Deep-sea sediments and palaeoceanography. Biogeochemical activity in deep-sea sediments. Appendix. Suggested further reading. Answers and comments to questions.

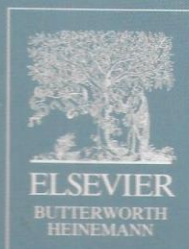
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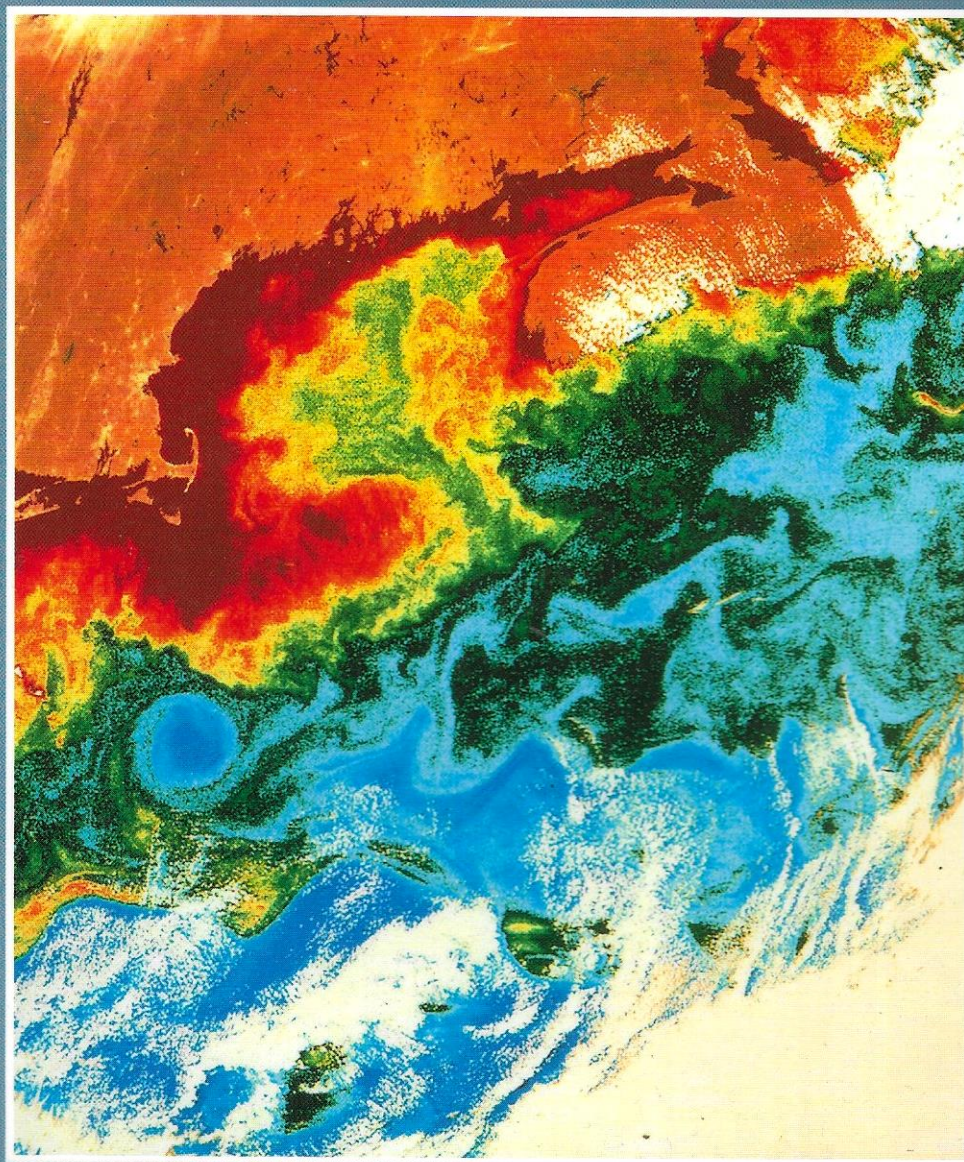
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# CASE STUDIES IN OCEANOGRAPHY AND MARINE AFFAIRS

PREPARED BY AN OPEN UNIVERSITY COURSE TEAM



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### **S330 VOLUME 6**

This Volume belongs to a series on oceanography. It is designed so that it can be read on its own or studied as part of the Open University third-level course, S330 *Oceanography*. Chapter 1 looks at how we use the oceans, and Chapters 2 and 3 consider the development of the Law of the Sea up to the present day (UNCLOS).

The hydrocarbon-rich but ice-bound Arctic forms the Case Study in Chapter 4 where conflicts over sovereignty and rights of passage are considered alongside environmental problems. Finally, Chapter 5 discusses the equatorial Galápagos Islands, around which there is a Marine Resources Reserve. By looking at the islands' oceanographic setting, the Case Study provides an insight into how they acquired their unusual flora and fauna, and explains why they are vulnerable to El Niño events.

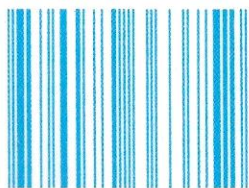
### **CONTENTS**

Marine resources and activities. Legal background. Present international legal regime. The Arctic Ocean: ice, oil and sovereignty. The Galápagos: islands of variety and change. Suggested further reading. Answers and comments to questions.

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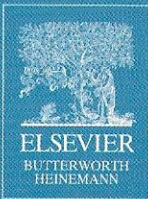
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# BIOLOGICAL OCEANOGRAPHY AN INTRODUCTION

## SECOND EDITION

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This popular undergraduate textbook offers students a firm grounding in the fundamentals of biological oceanography. As well as a clear and accessible text, learning is enhanced with numerous illustrations (including a colour section), thorough chapter summaries, and questions with answers and comments at the back of the book.

The comprehensive coverage of this book encompasses the properties of seawater which affect life in the ocean, classification of marine environments and organisms, phytoplankton and zooplankton, marine food webs, larger marine animals (marine mammals, seabirds and fish), life on the seafloor, and the way in which humans affect marine ecosystems.

The second edition includes a new chapter on human impacts – from harvesting vast amounts of fish, pollution, and deliberately or accidentally transferring marine organisms to new environments. Other new material includes revised primary production figures based on satellite imaging, new information on the smallest marine organisms (prochlorophytes and viruses), an examination of long-term changes in zooplankton and fish populations, and an introduction to recent developments in measuring biological parameters and capturing marine organisms.

This book complements the Open University Oceanography Series, also published by Butterworth-Heinemann, and is a set text for the Open University third level course, S330.

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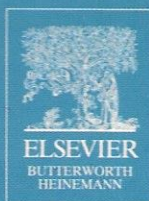
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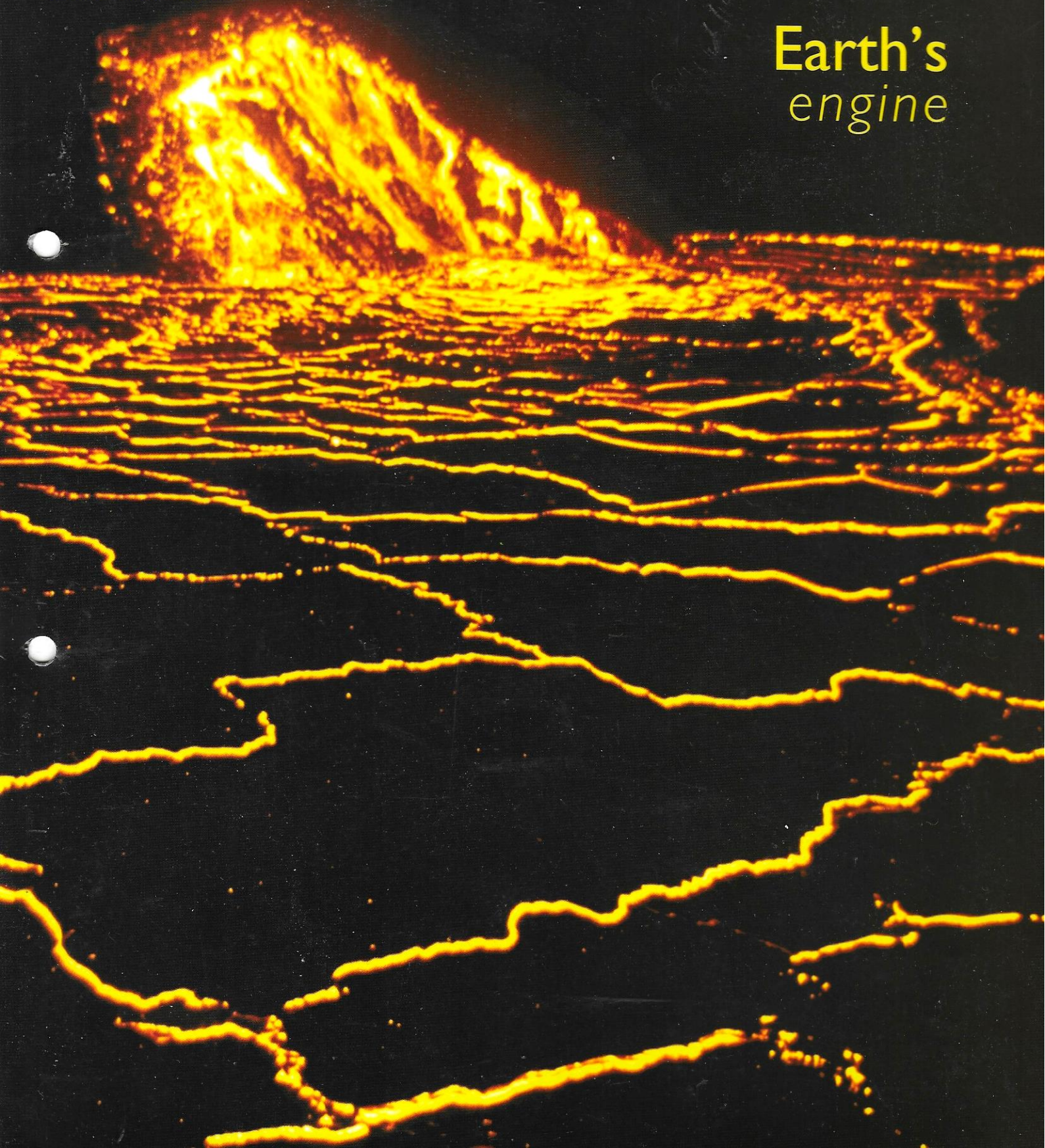
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# Earth's *engine*







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**Block 4 Mountain building**

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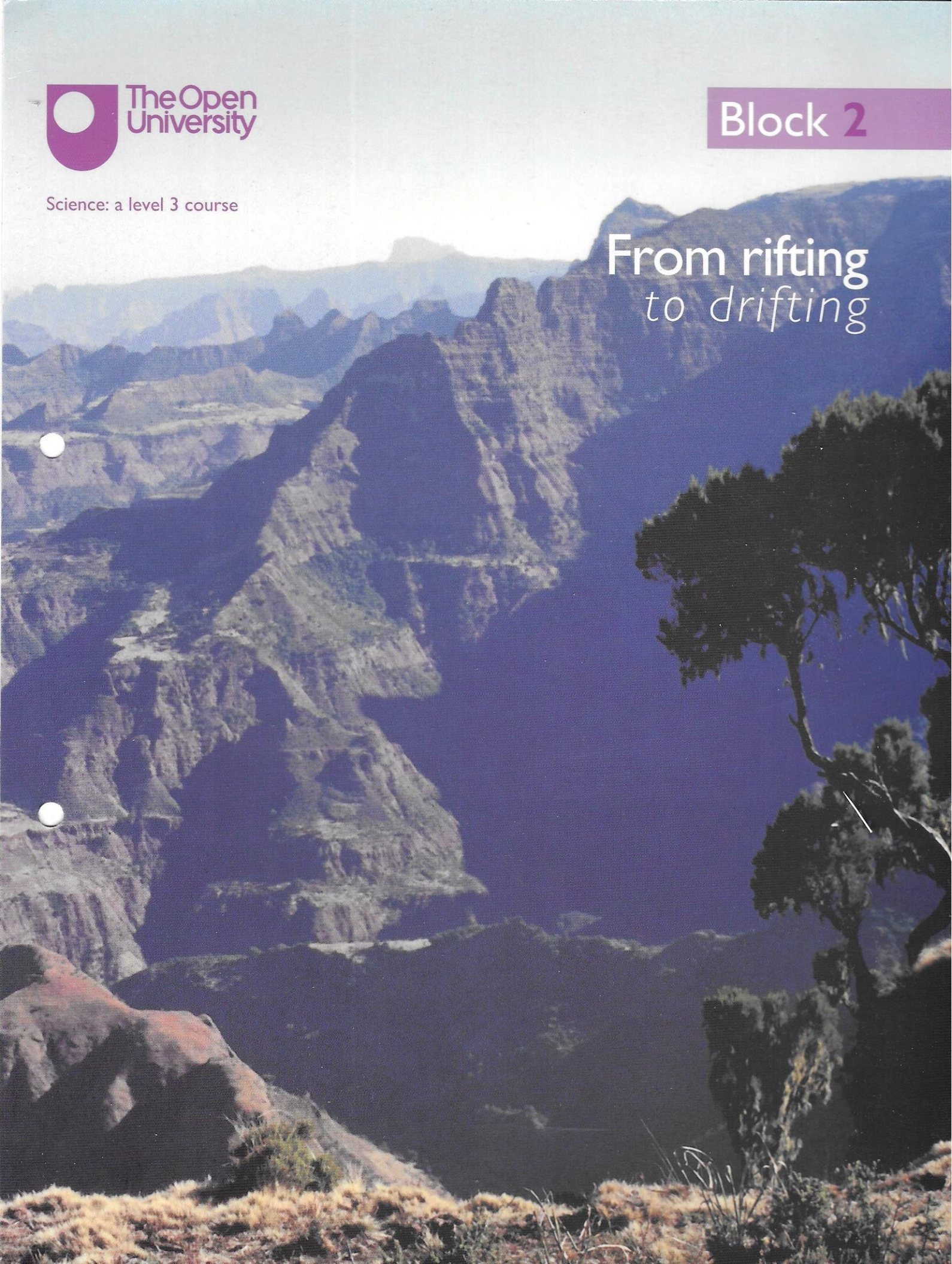


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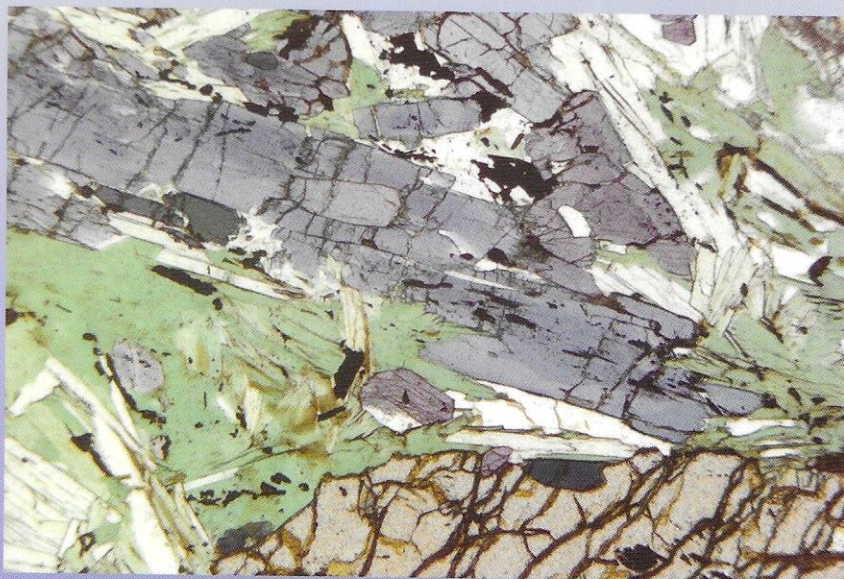
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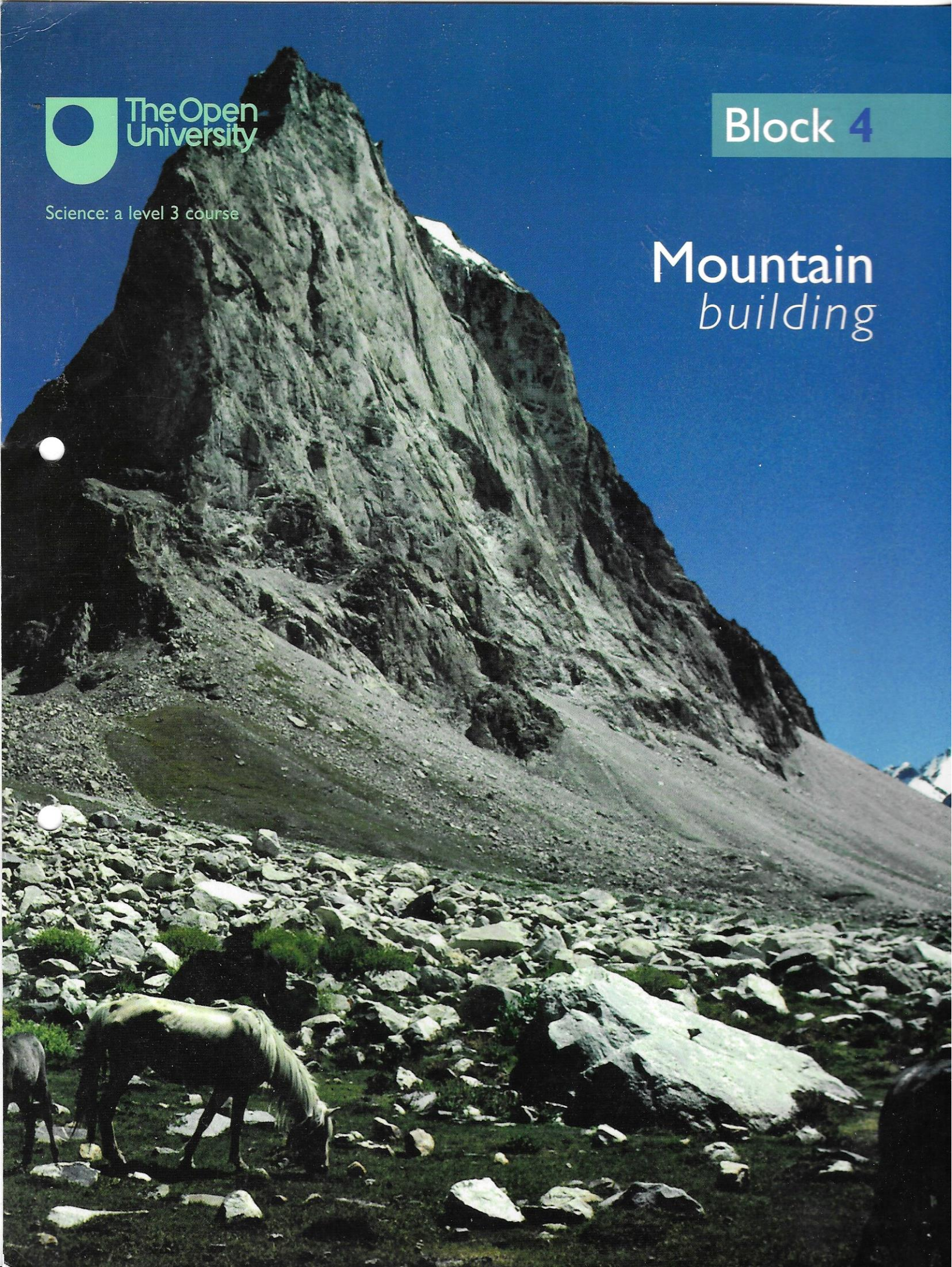




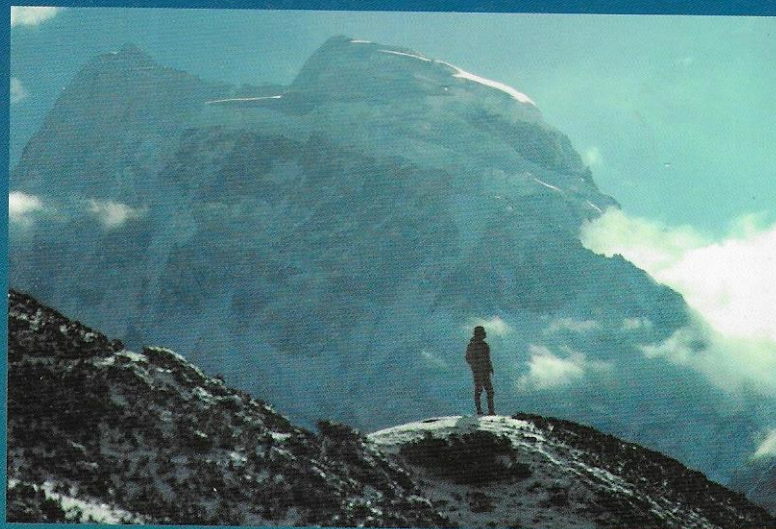
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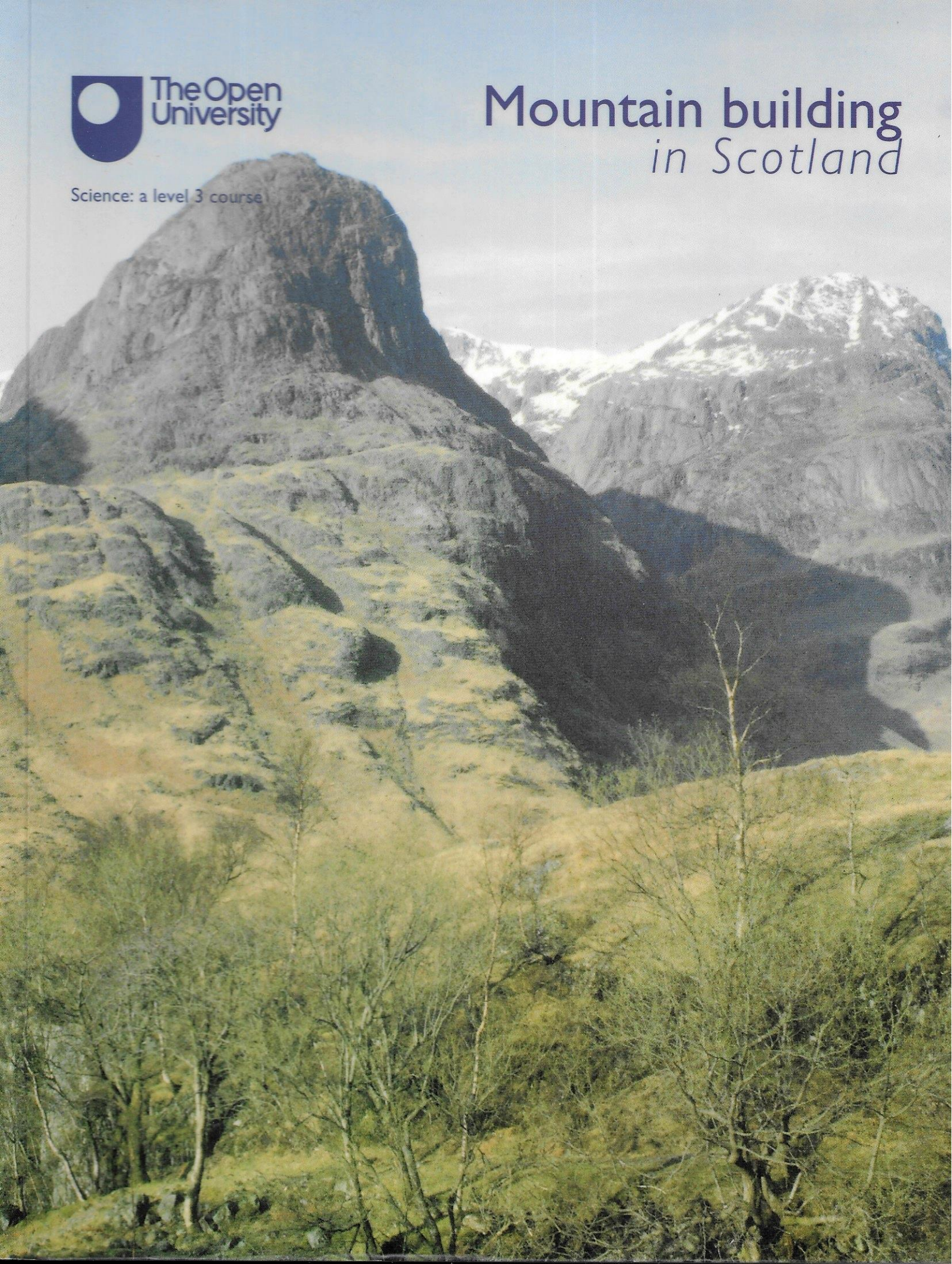
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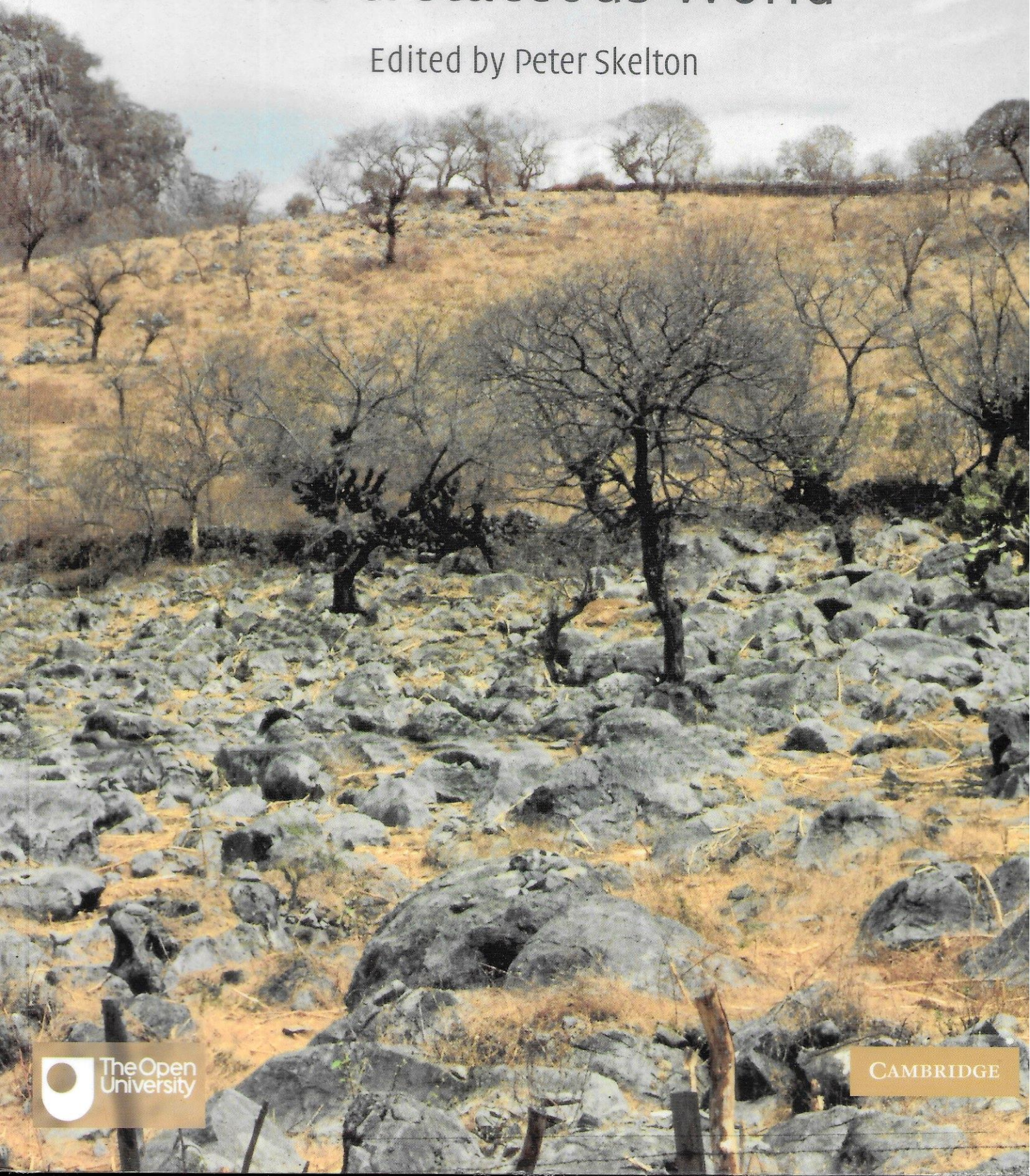
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# The Cretaceous World

Edited by Peter Skelton





# The Cretaceous World

**Peter W. Skelton** *The Open University, Milton Keynes, UK*

**Robert A. Spicer** *The Open University, Milton Keynes, UK*

**Simon P. Kelley** *The Open University, Milton Keynes, UK*

**Iain Gilmour** *The Open University, Milton Keynes, UK*

The rich geological record of the Cretaceous Period reveals a world that experienced extreme climatic warmth and significantly higher global sea-levels than today. It therefore provides a natural case study of the Earth in 'greenhouse' climatic mode, which this interdisciplinary textbook analyses from the perspective of Earth System Science. With mounting concerns over global warming today, an understanding of how the Earth system operates when in greenhouse mode is very relevant to studies of future climatic change. After surveying the evidence for conditions on the Cretaceous Earth, this book explores the interactions between the physical, chemical and biological processes occurring both within the Earth and at its surface. These processes control the prevailing environmental conditions on Earth and the book highlights the major differences between the Cretaceous and the present world. Comparison of the global carbon cycle, then and now, is emphasized, although other relevant biogeochemical cycles are also discussed. Finally, the infamous mass extinction that terminated the period, and its possible causes, are investigated.

Designed for use on undergraduate and graduate courses, this textbook includes many features that will aid tutors and students alike, including:

- numerous full-colour figures and photographs throughout;
- an introduction to modelling of biogeochemical cycles and atmospheric and oceanic circulation in order to reconstruct past climatic conditions;
- boxed summaries of supplementary and background information, as well as chapter summaries;
- bulleted questions and answers throughout the text;
- a supporting website: <http://publishing.cambridge.org/resources/0521831121> hosting sample pages, selected illustrations to download, and worked exercises.

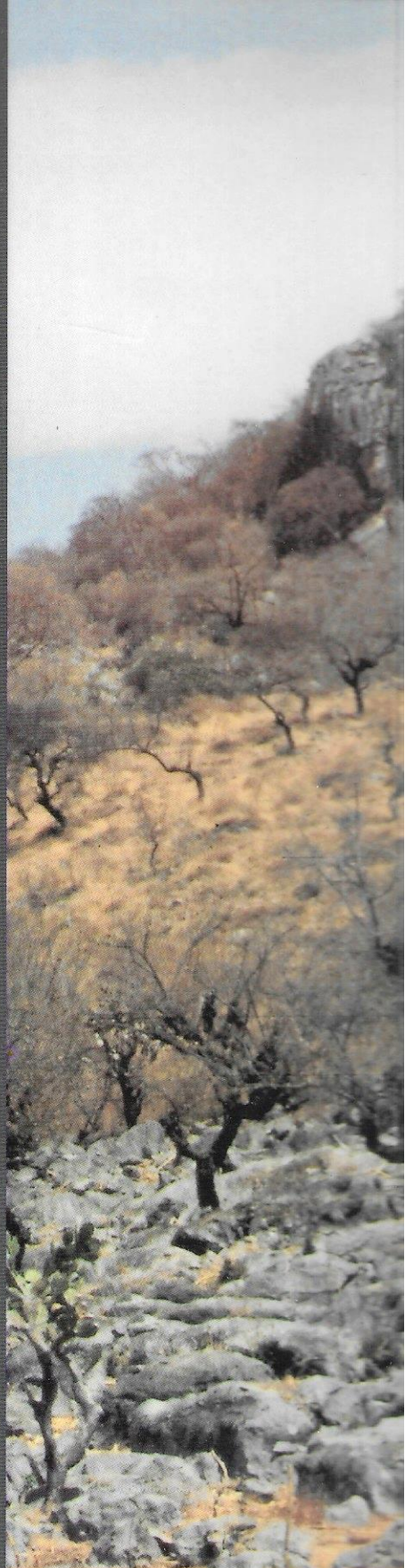
## Advance praise for this textbook:

*'This book succinctly presents the new ideas of Earth System Science — that Earth processes are interlinked and part of a much bigger picture — the hydrosphere, biosphere, atmosphere and geosphere are all dependent on each other and part of a global system. In many parts of the book, general principles of techniques and concepts are presented before application to the Cretaceous — so there is much to be gained by all Earth science students from reading this text. The book is beautifully illustrated with coloured figures and photographs, the latter coming from all over the world. The text is very readable and there are useful questions scattered throughout to enable students to ponder the significance of topics. I highly recommend this book to all Earth Scientists — students and professional alike. The Open University team are to be congratulated on producing a fine textbook.'*

**Professor Maurice Tucker** *University of Durham, UK*

*'This is a very well-written book, filled with up-to-date material, and should be a challenging read for the best undergraduate students in geology. I would recommend this book as a supplementary text for several courses at my university and would encourage graduate students to add a copy to their library. Anyone doing research on the Cretaceous Period should have a copy.'*

**Professor Wayne Ahr** *Texas A & M University, USA*



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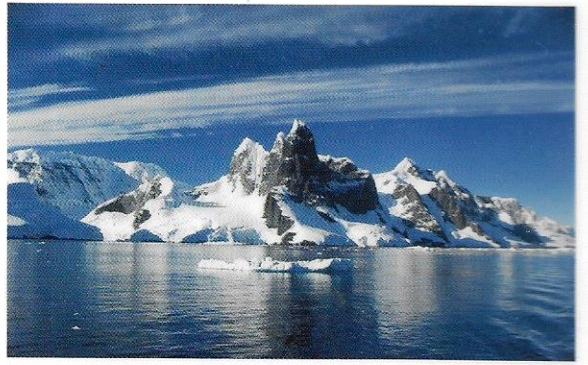


# The Great Ice Age





Glaciers spilling over from the  
Danco Coast, Antarctica into  
the Southern Ocean. Image  
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# The Sedimentary Record of Sea-Level Change

Edited by Angela L. Coe



# The Sedimentary Record of Sea-Level Change

**Angela L. Coe** *The Open University, Milton Keynes, UK*

**Dan W. J. Bosence** *Royal Holloway University of London, UK*

**Kevin D. Church** *The Open University, Milton Keynes, UK*

**Stephen S. Flint** *University of Liverpool, UK*

**John A. Howell** *University of Bergen, Norway*

**R. Chris L. Wilson** *The Open University, Milton Keynes, UK*

This unique textbook describes how past changes in sea-level can be detected through analysis of the sedimentary record. In particular, it concentrates on the theory of sequence stratigraphy, which provides a framework for how entire sedimentary systems evolve through geological time. Sequence stratigraphy is a model for dividing the sedimentary record into discrete, genetically related packages on a range of length- and time-scales, where each package represents a cyclic change in sea-level and/or sediment supply. This technique is widely used to understand the genesis of the sedimentary record, to examine the global synchronicity of sedimentary cycles and in the exploration for hydrocarbon reserves.

Designed for undergraduate and graduate courses in sequence stratigraphy, as well as for professional courses within the petroleum industry, this textbook includes many features that will aid tutors and students alike, including:

- numerous full-colour figures and photographs throughout;
- detailed case studies demonstrating the applications of sequence stratigraphy;
- boxed summaries of supplementary and background information;
- bulleted questions and answers throughout the text;
- a supporting website <http://publishing.cambridge.org/resources/0521831113> hosting sample pages, selected illustrations to download, and worked exercises.

## Advance reviews of this textbook:

*'The main body of this book constitutes a fine presentation of the principles of sequence stratigraphy and their application to clastic and carbonate examples. The use of the Book Cliffs as the main clastic example is an excellent choice. The authors clearly know this area well, and their descriptions and interpretation are well done; they take into account all of the various hypotheses and controversies that have arisen around these rocks. The writing is clear and straightforward and the illustrations are truly excellent.'*

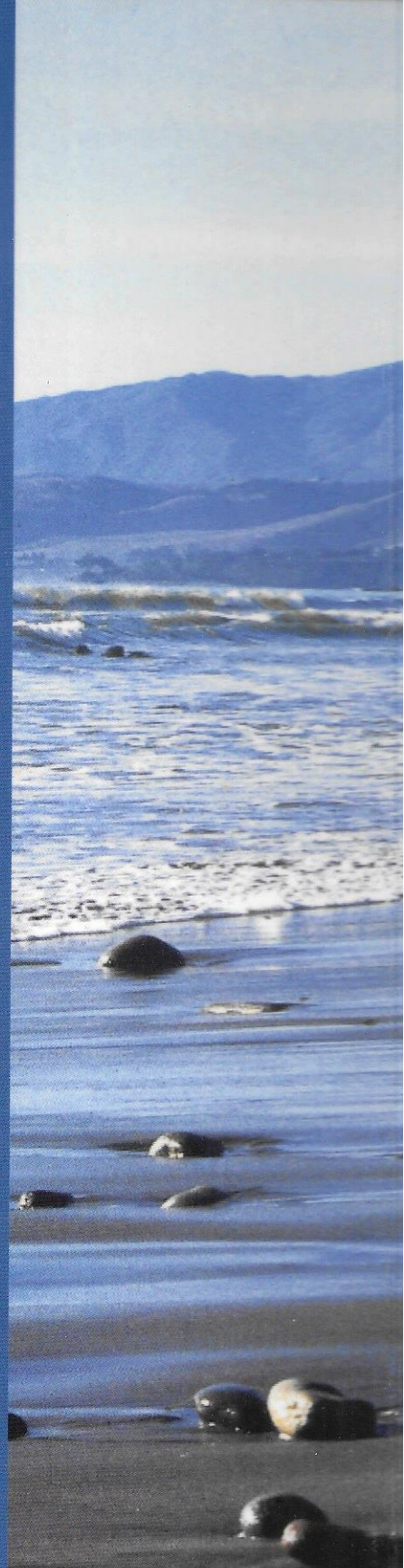
**Professor Andrew Miall** *University of Toronto, Canada*

*'This textbook is simply without equal and there are no competing texts in this field. I have been amazed that it has taken so long for any textbook at the introductory level to give a complete and accurate treatment of sequence stratigraphy, and this text does it remarkably well. There is a clear need for a text such as this in any advanced undergraduate stratigraphy course. The text is logically laid out and the explanation of sequence-stratigraphic principles is perhaps the most lucid I have read anywhere.'*

**Dr Steven Holland** *University of Georgia, Athens, USA*

*'This book has a lot to commend it. The approach to the subject of sequence stratigraphy using well-documented case studies is excellent, and as such the book fills an important niche in the market. Even the areas where there is overlap with other books, this text is better than others: indeed, it is the best summary of the concepts of sequence stratigraphy I have ever read. It is also a very well-written text. The style is clear and consistent throughout, a tribute to some very high quality editing of a multi-author book. Furthermore, the illustrations, both line drawings and photographs, are of extremely high quality, and they very effectively complement the text.'*

**Dr Gary Nichols** *Royal Holloway University of London, UK*



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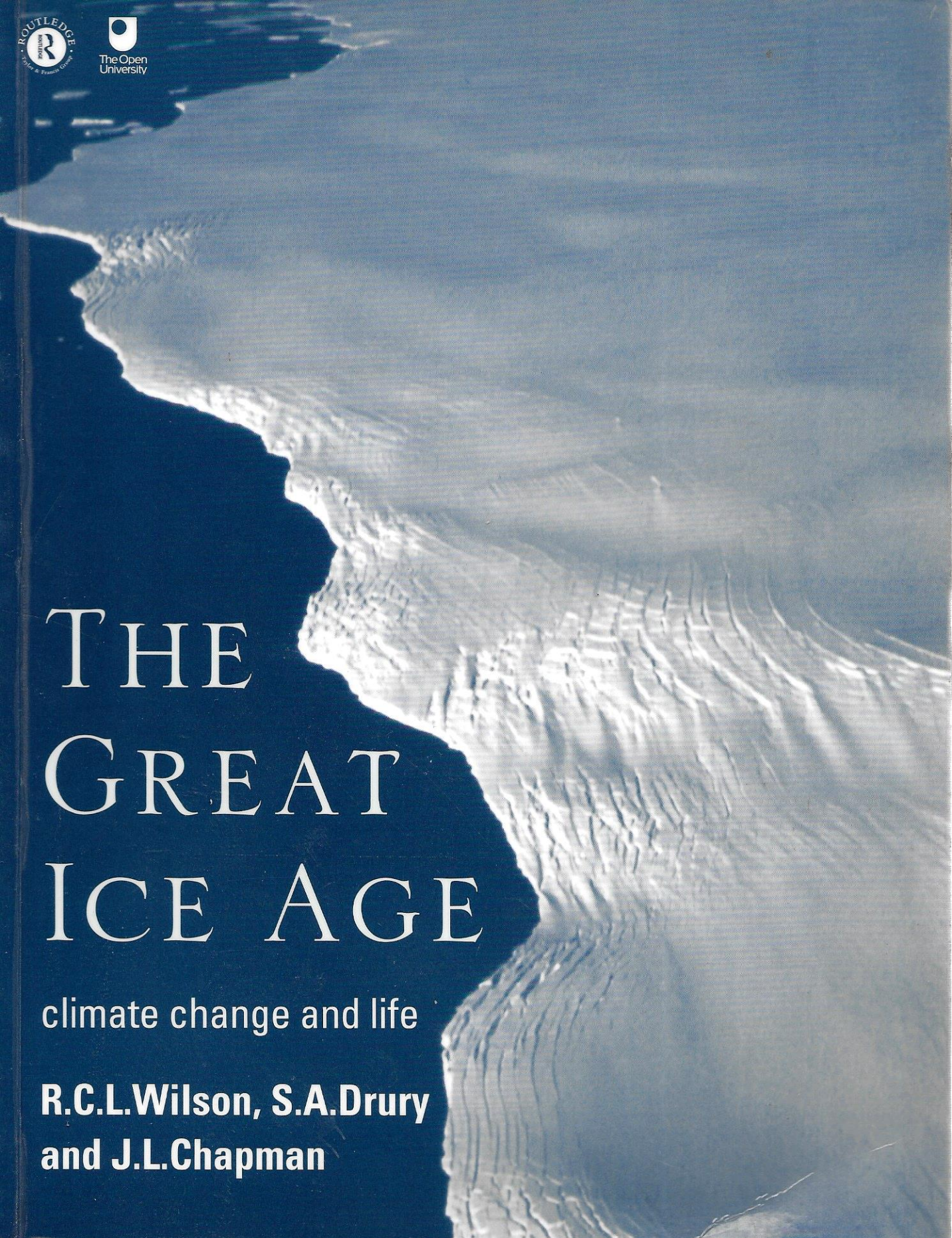
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# THE GREAT ICE AGE

climate change and life

**R.C.L. Wilson, S.A. Drury  
and J.L. Chapman**



**THE GREAT ICE AGE** is also our age. The four-and-a-half-billion-year evolution of the Earth and its biota culminated in the appearance of a life form capable of studying and manipulating the planetary systems at a time when the Earth experienced rapid and regular climatic changes. With human consciousness focusing as never before on the world around us, we are now beginning to realise the enormity of the global experiment we are conducting as the 'conscious forcing function' in the evolution of the Earth system.

Part I of *The Great Ice Age* documents the dramatic climatic changes that have occurred over the last 2.6 million years of the Earth's history, and Part II outlines ways in which these affected life and the evolution of humanity.

Much of Part I is a detective story, discussing the clues (proxy climate indicators) that palaeoclimatologists use to reconstruct past changes and how they attempt to explain them. An underlying theme of this story is the interconnectivity of all the components of the Earth's climate system. The array of evidence from oceanic and terrestrial realms shows that climate change occurred over a range of time scales from millions of years, through tens of thousands of years, to more rapid changes that occurred over decades or centuries. The final chapter outlines a number of explanations for climate changes, none of which adequately explains all the evidence documented in earlier chapters. The challenge of formulating an all-embracing model that explains all the clues that have been amassed drives palaeoclimatologists to seek more knowledge of the past. Their work also illuminates the possible courses of future climate change, for if models can explain the past, our confidence in their ability to make predictions about future climate trends will be increased. This is the only way we can evaluate the possible consequences of the global environmental experiment that humanity is conducting.

In Part II, some of the biological effects of the climatic upheavals described in Part I are examined, focusing on both human anatomy and the way in which conscious social behaviour responded to these rapidly changing selection pressures. Increasingly they drove human beings towards mastery of their surroundings and away from passive and purely biological responses. Shifting and changing ecosystems and sea levels combined with unique human characteristics to spread our forebears and their growing influences further and wider than any other species. Human origins presaged a mass extinction that has the pace and perhaps magnitude of others in the far-off past that stemmed from geological and occasionally extraterrestrial events. Anthropogenic change of the world is not new, but extends back a million years or more.

**R.C.L. Wilson** is Professor of Earth Sciences and **S.A. Drury** is a Lecturer in Earth Sciences, both at the Open University, Milton Keynes; **J.L. Chapman** is Honorary Research Associate of the Sedgwick Museum, University of Cambridge.

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# ENERGY, RESOURCES AND ENVIRONMENT



EDITED BY JOHN BLUNDEN AND ALAN REDDISH



## *Energy, Resources and Environment*

Energy and minerals are vital to our technological society, but the extraction, refining, use and disposal of minerals (including coal, oil and uranium) create some of our most severe environmental problems. This book analyses the impacts of current systems of energy and mineral supply and use (from acidified water to radioactive pollution) and explores possible alternatives. Mineral substitution and recycling, energy conservation and sustainable supplies from wind and waves may all have a part to play.

The move to less damaging methods is not just based on altruistic analysis. The history of state regulation shows that governments have been reluctant to damage the interests of industry. Although the European Community is moving towards tighter and more homogeneous controls, public alarm about catastrophic accidents and toxic and nuclear wastes has been a key influence on political debates and decisions.

Like the other books in the series, *Energy, Resources and Environment* is both approachable and authoritative, and has been prepared by a team of specialists in the light of latest knowledge. It is not only interdisciplinary but also integrated, stressing the need to relate scientific knowledge, technical possibilities and political and economic decision-making in the light of an environmentalist philosophy.

This book will appeal to anyone with an interest in environmental issues, as well as sixth-formers and undergraduates studying interdisciplinary environmental studies, geography, ecology or energy and materials technology.

John Blunden is Reader in Geography in the Faculty of Social Sciences and Alan Reddish is Lecturer in Electronics associated with the Energy and Environment Research Unit in the Faculty of Technology, both at The Open University.

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